স্মৃতিগ্রন্থ
स्मारिका
Souvenir

বৃক্ষ উৎপাদক মেলা
वृक्ष उत्पादक मेला
TREE GROWERS' MELA

7 & 8 March, 2024

Sponsored by
CAMPA

Organized by
ICFRE-RFRI, Jorhat, Assam

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सत्यमेव जयते

कंचन देवी, भा.व.से.
Kanchan Devi, IFS

कुलाधिपति, व.अ.सं. विश्वविद्यालय
Chancellor, FRI University

महानिदेशक
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद्
न्यू फॉरेस्ट, देहरादून - 248006
(आई.एस.ओ. 9001:2008 प्रमाणित संस्था)

Director General
Indian Council of Forestry Research and Education
P.O. New Forest, Dehra Dun - 248 006
(An ISO 9001:2008 Certified Organisation)

MESSAGE

It gives me immense pleasure to know that ICFRE-RFRI, Jorhat (Assam) is organizing a **TREE GROWERS' MELA** during 7-8 March, 2024 at its Deovan Campus, Jorhat, Assam to sensitize the Farmers, Tree Growers, Craftsmen, stakeholders, representatives from Wood/Bamboo based industries, officers and staff of all the Forest Departments of NE States, scientists and faculty from Research and academic institutions from different North Eastern States region on issues related to cultivation and management of tree species on farm lands, the technologies and products developed by the ICFRE and its institutes in the field of forestry, value addition and marketing of various NTFPs, skill development and livelihood options from bamboos and other local forest products such as broom grass, lac etc.

This Mela encourage local farmers, stakeholders and representatives of different institutions/departments to share their experiences on growing trees and bamboos on their lands, value addition livelihood options through forestry based activities as well as marketing of tree and bamboo and NTFPs based products. The Tree Growers' Mela would provide an opportunity to understand the issues related to tree farming. This will provide a platform to share their experiences as well as utilize their innovative ideas for future development.

I believe this Tree Growers' Mela will be a useful for farmers and tree growers and inspire them to pursue farming, which will enable enhancing incomes and green cover.

(Kanchan Devi)

दूरभाष / Phone : 0135-2759382 (O)
EPABX : 0135-2224855, 2224333 (O)
ई–मेल / e-mail : dg@icfre.org

Dr. Bidyut C. Deka
Vice Chancellor

ASSAM AGRICULTURAL UNIVERSITY
JORHAT-785013, ASSAM (INDIA)

(Recipient of Sardar Patel Outstanding Institution Award)

Message

I am happy to learn that the Jorhat based ICFRE-Rain Forest Research Institute is going to organize Tree Growers' Mela during 7-8 March,2024 at its premises which will help the local farmers, tree growers , artisans , wood and bamboo based entrepreneurs and other stakeholders of the forest resource management. I believe that the event will benefit the farmers immensely through sensitization programmes on cultivation and management of tree species,the technologies and products developed by Indian Council of Forestry Research & Education.

I congratulate the organizers for their noble endeavour for paving the ways of progress and welfare of the farming community at large and the bamboo and wood based entrepreneurs of Assam in particular. I thank the editorial team and the contributors of the souvenir.

I wish the programme a grand success.

(Bidyut C. Deka)

Phone: (91) 376 2340013(O), 2340050(R) Fax: (91) 376 2340001 Website: www.aau.ac.in Email: vc@aau.ac.in

सत्यमेव जयते
डा0 सुधीर कुमार
उपमहानिदेशक (विस्तार)

Dr. Sudhir Kumar
Deputy Director General (Extension)

भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद
(पर्यावरण, वन और जलवायु परिवर्तन मन्त्रालय, भारत सरकार की एक स्वायत्त परिषद)
(आई. एस. ओ. 9001:2008 प्रमाणित संस्था)
डाकघर न्यू फॉरेस्ट, देहरादून – 248 006 (उत्तराखण्ड)

Indian Council of Forestry Research & Education
(An Autonomous Body of Ministry of Environment, Forest & Climate Change, GoI)
(An ISO 9001:2008 Certified Organization)
P. O. New Forest, Dehra Dun – 248 006 (Uttarakhand)

Dated 1st March, 2024

MESSAGE

I am delighted to learn that ICFRE-RFRI, Jorhat (Assam) is organizing a **"TREE GROWERS' MELA"** from 7th March to 8th March, 2024 at its Deovan Campus in Jorhat district of Assam involving the Farmers, Tree Growers, Craftsmen, Stakeholders, Officers and Staff of all the Forest Departments, Scientists and faculty from Research and academic Institutions, representatives from Wood/Bamboo based industries from different North Eastern States region participation which is related to growth and development of agro-farming /agro-forestry sectors in the region. Such an event shall provide a platform to all the local farmers and stakeholders representatives of different institutions/departments to share their experiences on growing trees and bamboos on their lands.

I am extremely glad to know that a Souvenir is also being brought on this occasion. I convey my best wishes to the organizer and the editorial team of the souvenir all success in their endeavour.

I congratulate the organizers for the effort they have made in organizing an event of this magnitude. I earnestly wish that the **"TREE GROWERS' MELA"** will succeed in achieving its objective; I would like to convey my best wishes for the **MELA**.

(Dr. Sudhir Kumar)

दूरभाष /Phone: 0135 – 2750693 (O)
ई.पी.ए.बी.एक्स. /EPABX: 0135 - 2224830

फैक्स/ Fax : 0091-135-2750693
ई.मेल/e-mail: ddg_extn@icfre.org

केंद्रीय मूगा एरी अनुसंधान एवं प्रशिक्षण संस्थान
Central Muga Eri Research & Training Institute
केंद्रीय रेशम बोर्ड **Central Silk Board**
वस्त्र मंत्रालय, भारत सरकार **Ministry of Textiles, Govt. of India**
लाहदोईगढ़, जोरहाट – **785700**,असम **Lahdoigarh, Jorhat– 785700, Assam**
दुरभाष/**Phone:** 91-376 2305900
ई-मेल - /**Email:** cmerti@rediffmail.com, cmertilad.csb@nic.in

Dr. K.M. Vijaya Kumari
Director

D.O.No.CSB/CMERTI/PMC/7(39)/2023-24/2370 **Date:17.02.2024**

MESSAGE

It brings me great joy to learn about the upcoming "Tree Growers Mela" organized by the Indian Council of Forestry Research and Education (ICFRE)-Rain Forest Research Institute (RFRI), Jorhat, Assam, scheduled for the 7th and 8th of March 2024. The event aims to sensitize farmers and tree growers in the region about critical issues related to the cultivation and management of tree species on farmlands, emphasizing sustainable agricultural practices and agroforestry techniques for a greener and economically prosperous future.

In my capacity as the head of the R&D Institute for the development of Muga and Eri culture, I seize this opportunity to shed light on Sericulture, a rural agro-based industry. This industry not only provides substantial economic returns but also stands out as a key driver for socio-economic development, offering significant potential for employment generation. Having been actively involved in sericulture research for the past three decades, my focus has been on R&D development, entrepreneurship, and sustainable economic growth through active rural participation.

I encourage tree-growing farmers to explore the vast potential for income generation by cultivating perennial host plants for Muga and Eri silkworms. Embracing sericulture not only promises economic benefits but also contributes to the crucial cause of biodiversity conservation.

I express my heartfelt appreciation to the Organizing Team of ICFRE-RFRI, Jorhat, for their dedicated efforts in orchestrating this much-needed event and publishing the Souvenir. Their commitment to addressing essential topics reflects a commendable contribution to the advancement of sustainable agriculture and environmental stewardship.

Wishing the Tree Growers Mela immense success and hoping it serves as a platform for meaningful discussions, knowledge exchange, and collective efforts towards a brighter, sustainable future.

Place: Jorhat, Assam
Date: 17.02.2024

(K.M. Vijaya Kumari)

TEA RESEARCH ASSOCIATION
TOCKLAI TEA RESEARCH INSTITUTE
JORHAT - 785 008, ASSAM, INDIA
Ph. : 91-0376-2360467 (O), Fax 91-376-2360474
e-mail : director@tocklai.net,directortra@tocklai.net. website : www.tocklai.net

MESSAGE

I am extremely happy to know that, the Rain Forest Research Institute, Jorhat (Assam) is going to organize "*Tree Growers' Mela*" on 7th & 8th of March, 2024 at their Campus.

I am sure that, the 2 days programme will increase the awareness among the farmers, foresters and other counterparts of the society about the need for conservation of locally available medicinal and firewood/timber trees to mitigate future fuel scarcity by incorporate such trees in their plantations to enhance livelihood management and mitigation of climate change. It will give an opportunity to sensitize the farmers/tea planters/tea growers of this region on the various issues related to the cultivation and management of different tree species on farm lands besides the technologies and products developed by ICFRE and other Institutes under the Indian Council of Forestry Research & Education, values addition and marketing of different NTFPs, skill development and livelihood options from bamboos and other local forest produce like broom grass, lac and Agar wood etc. Farmers will get an insight into how forest produce other than timber can be harvested in a sustainable manner and marketed

Further the *Tree Growers' Mela* (TGM) would provide a platform for bringing together local farmers, tree growers, Arisans. NGOs/SHG/Small Tea Growers besides the various Management Committees of different forest division in Assam, Entrepreneurs and Industries associated with Wood and Bamboo in a common platform to share/exchange the knowledge and experiences for a better understanding of the core issues.

Tree Growers' Mela (TGM) would definitely spread awareness on tree cultivation using improved planting materials, including clones. Tree Growers Mela help as an integrating platform of farmers, scientists, industrial partners and government agencies to serve forestry research and market inputs to the tree growers, for enhancement of productivity and farm income.

I wish the forthcoming *Tree Growers' Mela* a great success

Dr. A. BABU, Ph. D
Director
Tea Research Association
Tocklai Tea Research Institute
Jorhat - 785 008, Assam, India
a.babu@tocklai.net

सत्यमेव जयते

Dr. Nitin Kulkarni
Director

भा.वा.अ.शि.प.-वर्षा वन अनुसंधान संस्थान
ICFRE-RAIN FOREST RESEARCH INSTITUTE
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद
Indian Council of Facresty Research & Education
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय, भारत सरकार
(Ministry of Environment, Forest & Climate Change, Govt. of India)
देवबन, जोरहाट-785010 असम/Deovan, Jorhat-785010 (Assam)

FOREWORD

It gives me immense pleasure and ignites a deepest responsibility to convey my warmest greetings and gratitude to all participants, enthusiasts, and supporters of the Tree Growers' Mela including the Farmers and Tree Growers of the North Eastern Region. As the Director of the ICFRE-Rain Forest Research Institute, it is indeed an honor to welcome you to this propitious occasion and to introduce the *Souvenir* that monumentalizes our collective dedication to the preservation and promotion of trees and forests thereby making our planet a safer planet to live in.

The Institute has been organizing Tree Growers' Mela (TGM) as an important element of its extension activity. The key objective of Tree Growers' Mela is to raise awareness among farmers and tree growers of the NE Region on issues relates to and management of tree species on farmlands, the technologies and products developed by the ICFRE and its institutes in the field of forestry, value addition and marketing of various NTFPs, skill development and livelihood options from bamboos, agarwood and other local forest products such as broom grass, lac etc.

The Tree Growers' Mela serves as a big platform providing opportunities for individuals and organizations to come together under a common umbrella which include local Farmers, Tree Growers, Artisans, Self Help Groups (SHG)s, NGOs, Joint Forest Management Committees working in different forest divisions, Wood and Bamboo Based Entrepreneurs and Industries, State Forest Departments and Forestry Research Organizations and share their knowledge, experiences, and innovations in tree cultivation, conservation, and management. It is a celebration of our shared commitment to safeguarding the natural world and ensuring a sustainable future for generations to come.

As you turn the pages of this Souvenir, I encourage you to reflect on the beauty and resilience of trees & forests and the pivotal role they play in sustaining life on Earth. Let us use this opportunity to renew our dedication to protecting and preserving our forests, not just for ourselves, but for all living beings that depend on them for their survival.

(Dr. Nitin Kulkarni)

पोस्ट ऑफिस/Post office : चेनीजान/ Chenijan, जोरहाट (असम)/Jorhat (Assam) - 785010, ईमेल/Email : dir_rfri@icfre.org
निदेशक/DIR. : फोन/Phone : +91376-2305101 (कार्या./W), +91-376-2305102 (नि./R), +91-376-2305130, (पीएस/PS), 09425325430

TREE GROWERS' MELA

Date: 07-08 March, 2024

Organized by
ICFRE-RAIN FOREST RESEARCH INSTITUTE,
JORHAT (ASSAM)

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- Mrs. Kanchan Devi, IFS, Director General, ICFRE, Dehradun, (Uttarakhand)

Convenor:

- Dr. Nitin Kulkarni, Director, ICFRE-RFRI, Jorhat (Assam)

Organizing Secretary:

- Sri R. K. Kalita, Scientist F & Head, Extension Division, ICFRE-RFRI, Jorhat (Assam)

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- Dr. D. J. Das, Scientist F & Head, FECC Division, ICFRE-RFRI, Jorhat (Assam)
- Sri Rajesh Kumar, Scientist F & Head, Forest Protection, ICFRE-RFRI, Jorhat (Assam)
- Sri Imotemsu Ao, IFS, DCF & Head, F & S, ICFRE-RFRI, Jorhat (Assam)
- Dr. Satyam Bordoloi, Scientist E & Head, GTI Division, ICFRE-RFRI, Jorhat (Assam)

TREE GROWERS' MELA COMMITTEE

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CONTENTS

The relevance of Rain Forest Research Institute- the need to contribute to socio-economic development of the region and scientific management of natural resources

R.S.C. Jayaraj, IFS (Retd.)
Ex-PCCF, Andaman and Nicobar Islands; Chairman,
UT Environment Impact Assessment Authority, A&N Islands

The Rain Forest Research Institute at Jorhat is one of the premier institutions of the Indian Council of Forestry Research and Education catering to the requirements of the northeastern region. It is a member of the NITI Forum for Northeast India, a Scientific Authority under the CITES and an off-campus centre of the FRI deemed to be university. With its unique position as a national level institution engaged in forestry research, education and extension it has to cater to the multiple needs of the society. It should help in bringing up the socio-economic status of the people and also provide the necessary scientific inputs for the environment and forest management in the region. The institute shall remain relevant to the region only if it strengthens its scientific manpower and capability to effectively address the societal, economic and scientific requirements of the region, elaborated below.

RFRI and economic development:

The society in the region is highly dependent on forestry sector for its day-to-day needs. In the olden days the requirements were mostly for subsistence which the forests were able to easily meet. Nowadays the requirements have increased with the globalised economy and adoption of modern lifestyle. The only dominant resource which can cater to the needs of the socio-economic development and meet the aspirations of the people is the 'environment and forests' abundant in the region. Over-exploitation of these resources to fast-track the economy in the recent past, has led to environmental degradation in most of the region, and the negative impacts are being felt now. If allowed to continue at the same rate, the region will have to face the vagaries of climate change and man-made disasters on a large scale.

Three major forest resources of the region that need to engage RFRI are the bamboos, agarwood and the timber resources. The Northeastern region is rich in bamboo resources both in terms of diversity and growing stock. However, the utilisable species for both domestic and industrial purposes are just a few. The statistics of growing stock are exaggerated counting more than 90 odd species most of which are not economically useful, or located in ecologically fragile regions, or not easily accessible through roads, and therefore practically not available for use. Therefore, there is a need for propagating the commercially useful species on a large scale in easily accessible areas both in forest and farmlands. Increasing the number of bamboo-based industries without commensurate enhancement of the resource base is not going to help in the long run. RFRI has done selections of high-yielding genotypes of bamboos and these

need to reach the farmers and industries. This can ensure at least ten to 15 percent increase in productivity. The silviculture of bamboos needs to be standardised and extended to the bamboo farmers, to augment the yield. In areas not suitable for agriculture, bamboo farming needs to be promoted on a large scale.

Agarwood is one of the most expensive non timber forest products produced in the region which can transform the economy drastically. It is mostly export oriented and can fetch large amounts of foreign exchange for the country and also boost the local economy while simultaneously conserving on-farm the critically endangered species of agarwood. RFRI had been working largely on the basic aspects of the plant, its genetic diversity, silviculture, propagation, its pest and pathogens and possibilities of artificial induction of agarwood. While these studies are far from complete there is a need for taking up research on the products also, especially, chips and oil, improved methods of their production, their grading, quality improvement and methods of tracking to aid in legal trade. Basic research into the genomics and metabolomics are also required to unravel the mechanisms of production of resins and to develop means to enhance their quantity and quality. This requires active collaboration with other research organisations with capacity in research related to genomics, metabolomics, chemistry and distillation processes. Only through collaboration the strengths of the organizations can be combined for a synergistic effect.

The Northeastern region Is also endowed with rich timber resources Since India is net timber importing country, the northeastern region can serve as a timber mine catering to the needs of the rest of the country and reduce the need for imports, if only the resources are properly managed. There is a need for genetic improvement of the timber species, establishment of seed sources and quality nurseries and plantations. The timber requirement is going to be largely met from plantations rather than natural forests in future. Development of quality seed is a prerequisite to ensure quality timber production. RFRI with its expertise in various aspects of tree improvement including genetics, seed technology, silviculture, and soil science is eminently placed in guiding the efforts of the forest departments and tree farmers in increasing the area under timber plantations.

Water is another abundant natural resource which needs to be managed for the human welfare. The drying up of springs in the upper reaches of the Himalayas and the flooding of rivers in the plains is a dichotomy that the region faces. Research in forest hydrology and afforestation of the catchments, river banks and flood plains are yet another requirement, expected of RFRI. Promotion of agroforestry can meet the needs of the society as well as the environment, conserving soil and water.

Social contributions of RFRI:

Being an institution of higher learning and research, RFRI has a mandate to upgrade the academic and technical skills of the people in the region. A large number of projects should be started, engaging research scholars and field assistants to the maximum extent possible. This will be a capacity building activity in the region, and these scholars would later cater to the needs of trained and skilled scientific manpower in schools, colleges, forest-based industries, plantation companies and the government departments dealing with natural resources. Even today the alumni of RFRI are spread all over the region, rendering service in a number of sectors, and this needs to be enhanced in scope. The extension programmes of the Institute should help in skilling the farmers and artisans so that they can increase the productivity of the plantations, and engage in manufacturing of forest products, which is a need of the hour in employment generation.

Scientific contributions of RFRI:

The research conducted at RFRI should feed into the requirements of management of natural resources. The findings of various projects should feed into the Working Plans of forest divisions, Management Plans of Protected Areas, Biodiversity Strategy and Action Plan, Climate Change Action Plan, Mining and Mine Reclamation plans of the mining agencies, and Catchment Area Treatment plans of the agencies managing rivers. The socio-economic studies should help in policy formulation by the Government, on how to manage the natural resources sustainably. While the basic research should help in strengthening the science, the applied research should meet the needs of forest farmers and forest-based industries, especially those based on bamboos, agarwood and timber. RFRI should find a place in all the Bamboo Missions, Agroforestry boards, Agarwood Development Boards and the Research Advisory bodies and Academic Councils of Universities dealing with forestry in the Northeastern region.

Conclusion:

RFRI needs to think big and formulate mega-projects and programmes covering the entire northeastern region, while small projects can be taken up for basic research. The projects should be well distributed among all the eight States under its jurisdiction. An appropriate balance among the basic research and applied research has to be maintained. The scientific publications should reach a wider audience through quality journals, while extension literature in simple language should meet the needs of the stakeholders. The extension programmes need to be strengthened and diversified and spread all over the region. The labs, library, museum, herbarium, botanical garden should be used for educating the young minds about the resources of the region and the need for their conservation. Only that way RFRI will be able maintain its relevance in the region and cater to the welfare of people.

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Forest Carbon Markets: Incentivising Tree Growers for Climate Change Mitigation

V.R.S. Rawat
Former ADG (Forest and Climate Change)
ICFRE Hqs Dehradun

1. Overview

Amidst global climate change concerns, role of forests has been increasingly recognized as most cost-effective option for climate change mitigation through carbon captured in biomass and soils. Managing forests and tree plantations for carbon sequestration offers the opportunity to reverse or stabilize GHG emissions from fossil fuels and land use. The role of forest and other carbon sinks associated with land use changes are recognized by UNFCCC as a relatively cost-effective way of offsetting emissions along with significant co-benefits. Combined with ecosystem restoration, afforestation, reforestation, and improved sustainable forest management, forest carbon has global potential to remove almost eight billion tonnes of carbon dioxide annually ($GtCO_2$-eq) from the atmosphere. In recent years, carbon market approaches have been increasingly embraced as a means to incentivise emission reductions and removals from the land-use sector. Climate change mitigation by way of capturing atmospheric carbon dioxide is one of the forest ecosystem services that is fully measurable, reportable and verifiable and has the potential to be traded in domestic and international carbon market. Carbon trading or offsets can be an attractive financial incentive for farmers and tree planters, communities for enhancing both carbon storage (sink) and sequestration through tree plantations.

2. Carbon Markets

With United Nations Framework Convention on Climate Change (UNFCCC) and its offshoot, the Kyoto Protocol, carbon became a tradable commodity to facilitate climate change mitigation through reduction of GHGs. The Kyoto Protocol established the first international carbon market system under UNFCCC compliance regime. Along with Kyoto type of compliance markets, voluntary carbon markets also started booming. Carbon markets transacts quantified units known as carbon offsets (or credits) which represents one metric tonnes of CO_2eq that has been reduced avoided or sequestered by an entity to compensate for emitting the same quantity elsewhere.

Compliance markets are used by companies and governments that by law have to reduce GHG emissions. The compliance market is regulated by mandatory national, regional or international carbon reduction regimes. Offset/credit buyers are entities with regulatory obligations.

Voluntary markets are the collective global transactions that are not driven by regulatory obligations. Anyone, for example, local governments, a company, an individual, any entity etc. can buy an offset. No single marketplace exists but rather a diverse and growing landscape of exchanges and over the counter (i.e., bilateral transactions) also take place under voluntary markets.

The transition from the CDM mechanism under the Kyoto Protocol to Article 6 mechanisms (or New Market Mechanism) under the Paris Agreement has potentially important implications for the continuation of existing mitigation activities established through the CDM. Market based strategies for carbon mitigation have witnessed rapid expansion since the 2015 Paris agreement. Article 6 is one of the key outcomes of the

Paris Agreement which allows parties to voluntarily cooperate with one another to achieve the emission reduction targets. By making it clear that countries can transfer carbon offsets internationally to deepen their emission reductions, Article 6 of Paris Agreement explicitly enables international carbon trading.

Carbon credits from forest-based activities have so far been very attractive option for the voluntary markets. However, with New Market Mechanism under Paris Agreement (PA) especially Article 6.2 on cooperative approaches, nature based (Forestry) activities are likely to be the preferred choice to reduce GHG emissions at relatively lower cost along with other significant co benefits of forest ecosystem services. Market mechanism under article 6.4 of the PA will also be emerging as a robust carbon market for climate mitigation.

3. Carbon forestry Project conceptualisation

A carbon project involves more than quantifying carbon benefits. It must contribute to environmental and economic well-being of the participating communities, contribute to sustainable development and must be additional to business-as-usual scenario. This has to be kept in mind throughout project design and project feasibility assessments. There are two types of activities involved to generate a carbon credit. First, activities that are specific to forest management like selection of tree species, plantation activities, improved forest management and calculating the carbon accrued in various carbon pools. The second part more complex part is project design component – i.e. documenting the carbon benefits created by the project activities and getting them certified under a specific standard.

From the outset the project proponents need to define the type of project, project's objectives and the activities to achieve the stated objectives based on the local conditions on ground, project location, type of land use category and state of forest for implementing the project activity. Conduct an analysis of feasibility of implementing the project activity. Project proponent also need to look for project participants and partners willing to participate in implementing activities and reaching objectives. Economic returns and financial well-being of the participating communities, local communities, private investors, should be a key component of project objectives. Multilateral and bilateral finance is also an option for financing the projects.

4. Typology of forest Carbon mitigation Projects activities:

Forests and tree plantations make a significant contribution to a low-cost global climate change mitigation opportunity that provides synergies with the adaptation and sustainable development. Carbon trading as a market-based approach has become an attractive option for climate change mitigation provides sustainable development of the forest community. The carbon market, where carbon offsets are certified, sold, and retired on registries, gives companies and individuals the ability to "purchase" carbon avoided or reduced in another project and/or area to offset their own emissions.

To create a carbon offset by planting trees and or capturing carbon in the forest and claim a future carbon reduction the project developer needs to register the project activity in a carbon registry. Carbon offset registries have established standards, documentation, third-party verification requirements, and monitoring protocols for projects to ensure that credits listed on their marketplace has been fully verified to ensuring the reductions are real and transparent. Registries act as a third party between project developers and buyers to ensure that the offsets sold deliver the promised environmental impact in a transparent and traceable way.

4.1 Afforestation/reforestation/ revegetation (Plantation activities): With UNFCCC and its Kyoto Protocol Carbon became a tradable commodity. The Compliance market like The Clean Development Mechanism (CDM) one of the carbon trading mechanism of the Kyoto Protocol under UNFCCC provides the carbon trading opportunities under afforestation and reforestation (A/R) category. About 19 CDM afforestation and reforestation project registered under CDM mechanism of Kyoto Protocol is already functional in India. The Kyoto Mechanism is now being replaced with new market mechanism currently known as article 6.4 mechanism (Market Mechanism) of Paris Climate Agreement. The Rules, Modalities and Procedures (RMP) of article 6.4 mechanism are still not finalised by the UNFCCC. New Project developer still need to wait for finalisation of RMP of article 6.4 mechanism.

Since the rules for forest carbon market under new market Mechanism of UNFCCC are still not finalised, the voluntary carbon markets are providing ample opportunities for forest carbon projects registering the projects under Agriculture, forestry and other land use (AFOLU) category. The global voluntary carbon markets are growing enormously. Growth of the carbon offset market and registries is being driven by an increasing number of businesses setting carbon reduction and net-zero goals as well as evolving regulatory requirements to reduce emissions. Since it's impossible for businesses to eliminate GHG emissions overnight, buying carbon offsets is now becoming an attractive option for companies to improve their environmental aspirations and continuing to reduce make carbon footprint in the long term.

4.2 Improved Forest Management (IFM) and REDD+ are other forest-based activities being registered under voluntary carbon markets. REDD also provide opportunity under the voluntary carbon markets. VCS, one of the leading Voluntary Carbon Standard allows only illegal, or unplanned, degradation and logging under the REDD category of Projects. Areas designated or approved for logging by government or authorised regulatory bodies like forest departments/ forest Corporations/ministries fall under the category of the Improved Forest Management (IFM). Shifting cultivation areas in NE region of the country offer good opportunity for small REDD+ projects under Voluntary Carbon Markets.

5. Policy support and domestic initiatives for forestry-based climate mitigation projects:

Promotion of forestry activities like afforestation, reforestation, forest conservation enhancement of forest carbon stocks and providing financial incentives to the forest steward, communities are amply reflected in various policies and programmes of the state governments in their state action plans for Climate Change (SAPCC). Under National Action Plan on Climate Change both states are committed to implement its flagship Green India Mission. In order to boost REDD+ Government of India has already approved National REDD+ Strategy for implementing REDD+ at national level.

5.1 **The Green India Mission:** In pursuance of India's commitments under its Nationally Determined Contribution (NDC), the National Mission for a Green India aims to create an additional carbon sink of 2.5 to 3.0 billion tonnes of CO_2 equivalent through additional forest and tree cover by undertaking restoration of open forests and afforestation/tree plantation on wastelands; plantations along national and state highways and railway tracks; urban landscapes, promotion of agroforestry, treatment of marginal farmlands and river catchments, etc. One of the strategies under the revised

GIM Document[1] is to tap voluntary carbon market for the sale of carbon of forestry origin for both forestry and agroforestry plantations. This area has not been explored so far, especially by the government agencies involved in afforestation due to various reasons including the absence of a national carbon market, but the initiative could be supported under GIM.

5.2 The Green Credit initiative: The Government of India, Ministry of environment, forest and climate has introduced 'The Green Credit Program' (GCP) in 2023[2]. Afforestation and water conservation are two main priorities of the initiative. It is an innovative market-based mechanism designed to incentivize voluntary environmental actions across diverse sectors, by various stakeholders like individuals, communities, private sector industries, and companies. The Indian Council of Forestry Research and Education (ICFRE) Dehradun has been designated as the GCP Administrator, responsible for program implementation, management, monitoring, and operation. In its initial phase, the GCP focuses on two key activities: water conservation and afforestation. It envisions the issue of Green Credits for plantations on waste/degraded lands and river catchment areas, to rejuvenate and revive natural eco-systems. Draft methodologies for awarding Green Credits have been developed and will be notified for stakeholder consultation. These methodologies set benchmarks for each activity/process, to ensure environmental impact and fungibility across sectors. The Green Credit Registry and trading platform, being developed by ICFRE would facilitate the registration and thereafter, the buying and selling of Green Credits.

To obtain Green Credits, individuals and entities must register their activities through the central government's dedicated app/website www.moefcc-gcp.in. The Administrator will verify the activity through a designated agency, with self-verification for small projects. Once verification is complete, the Administrator will grant a Green Credit certificate which will be tradable on the green credit platform.

6. Important steps in developing forest Carbon Project: Step-by-Step guidance

The following sections provide a step-by-step guidance for developing a carbon forestry project.

Step 1: Identification of potential project sites

Step 2: Planning of project activity, preliminary assessment of project scale and area

Step 3: Define key Participants:

Step 4: Effective Community Engagement:

Step 5: Draft a Project Idea Note:

Step 6: Conduct Feasibility Assessment of the Project:

Step 7: Project Design and Planning:

Step 8: Selecting an appropriate carbon standard (Registry) for registration of project activity

Step 11: Securing finance for Project Development:(i) Self-financed projects or (ii) Donor supported:

Step 12: Select a Methodology for the project

Step 13: Developing a Project Design Document

[1] MoEFCC (2021) Revised GIM document

[2]https://pib.gov.in/PressReleasePage.aspx?PRID=1967476

Step 14: Approvals, Validation, and Registration
Step 15: Project Implementation and monitoring:
Step 16: Verification and Issuance of certified Carbon Units

7. **General suggestions and outlook**

Climate change mitigation in forest sector by generating caron credits is now becoming an attractive option for private investment in forestry activities. Climate Change mitigation through forest carbon projects can deliver tremendous economic, social, and environmental benefits along with significant financial benefits to the participating communities. This article outlines the key steps for developing a successful forest carbon projects right from their inception, preparation of project design, selecting an appropriate carbon registry (Carbon standard) validation and registration, monitoring of the various parameters of the project, verification of carbon accrued and issuance of carbon credits. Clean Development Mechanism (CDM) of UNFCCC under compliance market had been one of the most sought-after standards for carbon projects. However, it is now being replaced by article 6.4 mechanism (New market mechanism of the Paris Agreement) for which rules are yet to be finalised, however, the Verified Carbon Standard (VCS) with largest volume of carbon projects in the voluntary carbon market is becoming an attractive option for tree plantations based carbon market.

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Agarwood, the Fragrant Treasure of North East India

Dr. Rajib Kumar Borah
GCR & Scientist-G
ICFRE-Rain Forest Research Institute, Jorhat

Northeast India is particularly significant for its precious wealth *Aquilaria malaccensis* locally known as "Agar" or "Xashi" and is considered to be the cradle of Agarwood aromatics with ancient traditions of Agarwood production which is thriving and growing. In use for over 2000 years for medicinal, aromatic and religious purposes, *Aquilaria malaccensis* is the preferred source of Agarwood for perfumery and religious traditions in the Middle East and in India. The Agar wood has a huge potential of creating another "Green Revolution" in Assam after tea. The low input for management and growth, lack of site specificity and intercropping adaptation make agar a preferred cash crop. In Assam, reputed to be India's "Agarwood Capital", where this critically endangered tree is quite adaptable to the land, a well planned policy is a need of the hour for supporting the Agar cultivation and its flourishing industries.

In North-East India, almost 20 million trees are under cultivation, of which, about 5 million trees are naturally infected and these are mostly confined to Jorhat, Golaghat, Sivasagar and Karimganj district of Assam as well as few pockets of Tripura due to the presence of stem borer (*Neurozerra conferta*) in these areas and the remaining 15 million trees are to be artificially inoculated. Further, there are almost 50 lakh trees in South-India in the states of Karnataka and Kerala and all these trees require artificial inoculation.

Further, raising of agar plantation is a long time investment as agar generally starts yielding after 20 years. Besides, all agar plants do not suffer from the infection in nature. So, even if agar is planted on a large scale, there is no guarantee that agarwood can be harvested in commercial quantities. Hence, research into possibilities of artificial induction of agarwood is need of the hour and may offer high economic return. Rain Forest Research Institute, Jorhat Assam has developed the technology for artificial induction of agarwood in *A. malaccensis* and successfully induced agarwood through artificial inoculation of fungi in healthy agar trees of Tripura, Meghalaya, North Bengal and North Bank Plain Zone of Assam.

Rain Forest Research Institute have launched two fungal inocula for artificial inoculation of agarwood in *Aquilaria malaccensis* and has been released for marketing in the brand name of "Sasi Inoculant". The product was inaugurated

by Honourable Chief Minister of Assam Dr. Himanta Biswa Sarma on 19th Aug, 2021. The product is available in two forms i.e. Liquid and Paste. With the adoption of Agarwood Promotion Policy of Assam and Tripura, this technology is expected to give a new dimension to the socio-economic condition of the entire North East Region.

The global demand for Agarwood has surged in recent years, leading to considerable economic opportunities for North East India. The region's Agarwood trade has attracted and attention from both domestic and international markets, providing income and livelihood opportunities to local communities engaged in the sustainable harvesting and processing of Agarwood. Across North East India, approximately 9.5 Lakh people are involved in this trade as well as cultivation. Depending on the oleoresin content of the wood, price varies from $20,000-$100,000 per kg. The price of essential oil is usually in the range of 30,000 USD per liter. According to a report by Global Agarwood Market Research, the global agarwood market size was valued at $8.64 billion in 2020 and is expected to reach $14.64 billion by 2028, with a CAGR of 7.8% during the forecast period. Demand for agarwood products in national and international markets offers significant trade opportunities for woodchips, powder, oil, fragrances, aromatic food, and tea. According to a study by Persistence Market Research, the global market for agarwood chips is expected to grow at 7.1% CAGR to reach US$ 87,467.6 Million by the end of 2033. If artificial induction technology of ICFRE- RFRI is properly implemented, it is anticipated to boost the economy of entire North East India. With concerted efforts towards sustainable harvesting, conservation, and eco-tourism, North East India can continue to be the custodian of this fragrant treasure for generations to come.

Artificial induction of Agarwood using Fungal technology

"Sasi Inoculant"

Honorable Chief Minister of Assam launching the product "Sasi Inoculant"

Religio-cultural perspective of tree conservation: glimpses from North East India

Dhruba J. Das
Scientist-F & Head, FECC, Division
ICFRE-Rain Forest Research Institute, Jorhat

In Indian context, trees are more than just another life form and component of the ecosystem. Trees are integral part of the life cycle in its totality and hold a deep rooted association with human beings and other creatures in its Socio-eco-cultural matrix. Trees are worshiped, revered, conserved and treated almost as another member of the family in many regions. Worshiping plants in general and trees in particular has been prevailing in many ethnic and religious groups across the world. It is even more prominent in India as many mythological lineages of tress can be traced back to the sacred texts. The earliest scripture like *Rig veda* have many hymns (*Suktas*) that unequivocally emphasizes the importance of plants in general and trees in particular. One such verse explicitly says *'Do not trouble trees, do not uproot or cut them as they provide protection to animals, birds and other living beings!'* The reference of trees keep on arriving almost in a cyclic order on a regular basis in *Rig Veda* and other holy books both *Smriti* and *Shruti* describing the relationship between humans, God and the universe. *Kath Upanishad*, II, iii, 1 pronounces: *"This (the world) is an eternal Ashwatth Tree whose root is above, but its branches are downward. It is He that is called the Bright One and Brahm, and Immortality, and in Him are all the worlds established, none goes beyond Him. This is That you seek for!" Bhagvad Geetaa, 15.1* reveals *"The Blessed Lord said – "There is a banyan tree which has its roots upward and its branches down and whose leaves are the Vedic hymns. One who knows this tree is the knower of the Veda!"* In the *Krishna Yajurveda Sanhitā-TS 3-5-7,* the names of the important trees and their qualities are clearly revealed and described. Vedic literature and in later part of the Indian history, Buddhism, Jainism and Sikhism hold special, sacred beliefs regarding nature in general and religious significance of trees in particular. Trees hold premier significance in Indian philosophy and almost every tree has a deity associated with it who is to be worshiped and respected.

Worship of trees and plants has been a documented part of religious practice in India since the hunting-gathering stage (circa 600 A.D.). Even now, Tree worship is very common in almost all over India. Various trees are believed to be associated with different Gods as per belief. However, there are elite members among trees; some trees that believed to hold direct association with the principal deities, possess extra importance than others. As for example, the Ficus tree (peepal), which is likely to be the mostly worshiped tree in India is associated with many deities, both major and minor. Lord *Brahma*, the creator, as it is

believed, is associated with the tree's roots; Lord *Vishnu*, the protector, relates to the tree's trunk and Lord *Shiva*, the destroyer God, believed to be associated with the leaves of the tree. In the context of larger Assam and Bengal provinces, *Shitala Mata*, the goddess of poxes (a minor deity), resides in a neem tree (*Azadirachta indica*). Apart from its purely religious importance, the banyan tree is also known as the tree of life. In many parts of India, it is considered as the symbol of life and fertility. Women hope to have children, or wish their husbands and children to have long healthy life, worship the banyan tree. Indian sages sang the praises of *asvattha* or peepal (*Ficus religiosa*), bargad or banyan (*Ficus bengalensis*), gular (*Ficus glomerata*), neem (*Azadirachta indica*), bel (*Aegle marmelos)*, Asoka (*Sereca indica*), amala (*Phyllanthus emblica*), Arjuna (*Terminalia Arjuna*) to name a few that acquired socio-religious sacredness. These plants were initially protected to meet the human day-to-day needs, but later on they were declared sacred as a mechanism to ensure their conservation. In a while, people started assigning religious inviolability to them which was followed by their successor generation after generation.

Worshiping plants in general and trees in particular is commonly known as 'Dendrolatry'. It signifies the tendency of many societies to worship and mythologizes trees. The innate cause behind this veneration lies in the deep gratitude people feel for plants which is the only medium that connects the living and nonliving things in the environment. As they are the only processors of solar energy, the source of all life on Earth, and can convert it to a form that human being can negotiate with. This is fundamental for human existence. These collective innate gratitude turns into reverence over a period of time and take shape of 'dendrolatry' in many societies. Appreciation for yielding flowers, fruit, wood and medicine are additional and add to the significance of trees on a day to day basis.

Divinity or sacredness is entrusted upon various trees by various ethnic groups of the world as a conservation mechanism as well. The followers of Shinto faith locates its shrines in '*Himorogi*', a forested sacred spaces used to worship, as it is believed that forests is the place where a divine ambiance prevails. Ami tribe of Taiwan also worships various plants and sacred plots of land, in the belief that Gods reside on them. In India, there are many sacred groves, each associated with one or more deities, are the biggest example of using 'sacredness' as a conservation mechanism or tool. It has been reported that more than fourteen thousand documented sacred groves are prevailing in India where as in North east India the number of documented sacred groves are more than six hundred.

In one of our studies, it was observed that, in Upper Assam in particular, *Ficus benghalensis* (local name: Bor) is the first choice for people of this region as a

religious tree followed by *Ficus religiosa* (Ahot), *Aegle marmelos* (Bel), *Ficus benjamina* (Jori), *Kydia calycina* (Koliori) and *Elaeocarpus ganitrus* (Rudraikhya). Interestingly all the above mentioned trees are associated with Lord Shiva, possibly the most important deities of this region. All the other tree species like *Lagerstromia speciosa* (Ajar), *Oxylum indicum* (Ghila), *Nyctanthus arbortristis* (Hewali), *Mangifera indica* (Aam), *Artocarpus lacucha* (Bohot), *Terminalia chebula* (Heelikha), *Delonix regia* (Krishnasura), *Bombax ceiba* (Simolu), and *Albizia chinensis* (phul shiris) were found in lesser numbers.

Another common yet interesting fact about people's collective fondness for trees lies in the fact that, name of many places in India is associated with the dominant or most noticeable trees of that locality. Some of the examples from many such places in North East India include Agartala (named after the Agar tree, or *Aquilaria malaccensis*), Amguri (named after *Manglfera indica*), Jamuguri (named after jamun, *Syzygium cuminii*), Ahatguri (named after *Ficus religiosa*), Udal guri (named after *Sterculia villosa*), kothalguri (named after *Artocarpus heterophyllus*), kadamtala (named after *Neolamarckia cadamba*), Baanskandi (named after bamboos), Shalganga (named after *Shorea robusta*), Pakariguri (named after *Ficus benjamina*), Salmara (named after *Shorea robusta*), Simulguri (named after *Bombax ceiba*), Uhlaguri, Amgaon (named after *Manglfera indica*), Amtola (named after *Manglfera indica*), Bethukandi (named after cane, *Calamus spp*.), Tamulpur (named after *Areca catechu*), Gua bari (named after *Areca catechu*, again) etc.

Trees are integral part and important members of our society. Growing more trees thus becomes a national duty for each one of us. This is important not only from ecological and economic view point but also from socio-religious and cultural

perspectives as well. Conservation of trees in and outside the forests (TOFs) is also equally important. Understanding of the vegetation composition of a locality along with its historical perspective gives us an insight about the past situation which is a prerequisite and guiding force for any conservation initiative.

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Growing Himalayan Alder in Jhum Land for Sustainable Land Management

Dr. Krishna Giri
Scientist-D
Centre of Excellence on Sustainable Land Management (CoE-SLM)
Indian Council of Forestry Research and Education, 248 006, Dehradun

The Himalayan alder (*Alnus nepalensis*) belonging to the Betulaceae family is an actinorhizal tree which fixes atmospheric nitrogen in symbiotic association with actinomycetes called *Frankia*. It has a broader distribution across the Indian Himalayan region. It is known by various names, such as *Rupo* in the Angami language in Nagaland and *uttis* or *utis* in the Western Himalayan region of India and Nepal. The alder-based jhum farming cum agroforestry system developed by the Angamis of Khonoma Village in Kohima district, Nagaland, is a well-known, time-tested land use system. More than 100-year-old alder trees grown in the jhum land are pollarded above 2-3 m from the ground, and leaves are burned in the field. Burning of leaf biomass of alder trees enriches soil fertility and suppresses weeds. The pollarded boles and branches of trees are used as firewood, timber, furniture making and other household-related requirements. Since the tree is deciduous or semi-deciduous, the leaf litter accumulation and decomposition during the fallow period enriches the organic matter, nitrogen and other nutrients in the soil. Jhum cultivation in the alder-based farming system is carried out for 2-3 years, followed by abandoning the land for 5-7 years. Land is rotated after 2-3 years of crop cultivation and the pollarding process is repeated in another piece of land. A variety of vegetables, legumes and millets are grown in the alder-based jhum farming system in Khonoma village. The overview of the alder-based jhum farming system is given in the figure.






Figure 1: Alder-based jhum farming system in Khonoma Village, Nagaland

Similarly, the jhumia farmers of the Wokha district have adopted the hundreds-of-year-old alder jhum farming model of the Angami community. The farmers of the Wokha district, Nagaland, have incorporated alder trees in their jhum fields and followed the periodical pollarding operation to enrich jhum fields. In addition, the farming community has also planted alder trees in their fallow jhum lands, which helps regenerate degraded jhum fallows faster and makes the system more fertile and productive. Besides, the alder jhum farming system is being adopted in other parts of Nagaland, where the tree species grow naturally or are introduced under similar pedoclimatic conditions. The alder jhum farming system of the Lotha ethnic community is shown in Fig. 2.

Figure 2: Alder jhum fields in Wokha, Nagaland

The alder jhum farming system evolved through the indigenous knowledge of the Angami ethnic community of Khonoma village is a unique traditional land use system in the Eastern Indian Himalayan region. Cultivation of alder trees in jhum lands enriches soil fertility and prevents soil erosion. Agrobiodiversity and crop productivity of alder jhum farming are higher than that of the conventional slash-and-burn jhum farming system practised in the Northeastern states of the country. This sustainable jhum cultivation practice has led to no villagers' dependency on forest resources for their livelihood requirements and conserved the rich biodiversity of the surrounding forests. Growing alder trees in the jhum fields under similar pedoclimatic conditions can transform slash-and-burn jhuming practice into a sustainable land use practice. Transformation of jhum lands into alder-based jhum cum agroforestry shall contribute significantly to sustainable land management and achieving land degradation neutrality.

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Models for Soil Carbon Monitoring: A New Approach

Dr. Gaurav Mishra[1] and Kingshuk Modak[2]

1. Scientist- D, Centre of Excellence on Sustainable Land Management, Indian Council of Forestry Research and Education, Dehradun-248006, Uttarakhand

2. Scientist-B, ICFRE-Rain Forest Research Institute, Jorhat-785001, Assam

Soil carbon (C) is one of the most significant indicators and is known to offer numerous ecosystem services (ESs) such as controlling greenhouse gas (GHG) emissions, reducing the effects of climate change, boosting soil productivity, and regulating the water cycle. The global estimates of the pedologic stocks to 1-m depth are 2300 Pg (1 Pg = 1015 g) for soil C (including both organic and inorganic), which is 2 to 3-fold higher than atmosphere and vegetation pools. Soil C is considered an essential parameter of soil health assessment, as it represents both the chemical and biological nature of soil. Moreover, it is an important indicator to monitor land degradation, rehabilitation, and restoration approaches for achieving land degradation neutrality and sustainable development goals. With the growing worldwide concern about soil degradation, it becomes essential to have efficient techniques for soil C monitoring. Monitoring and reporting of soil C due to changes in land uses is indispensable and the same needs to be explored at the regional levels, like hilly regions of the Northeast Himalayas, where changes in land use aggravated the issues of land degradation.

Different models are developed (RothC, CENTURY 5.0, EPIC, and CarboSOIL) and are increasingly being used nationally and globally to assess the effects of land-use change and climate change on soil C. These models predicted the cumulative carbon sequestration potential of soil under different practices and conditions, while some of them also provide information on future GHG emissions. The perquisite of these models includes complexity and requirements of input information about soil, weather, crop and carbon inputs. In general, simple models need less complicated and less detailed input information than complex models.

RothC is a monthly time step model and widely used to simulate changes in SOC stocks since 2000, using a few but easily available inputs like average monthly rainfall, evaporation, air temperature, soil condition, clay content in soil and decomposed SOC. However, the CENTURY 5.0 model needs more information like spatial distribution land use categories, soil texture, pH, bulk density, layers definition and depth, hydraulic properties, actual gridded climate and climate projections. This model can simulate the dynamics of C, Nitrogen (N), Phosphorus (P), and Sulphur (S) for various land-use systems, in addition to the analysis of global climate change. The Environmental Policy Integrated Climate

(EPIC) model is a process-based computer model used for long-term simulations of physico-chemical processes that occur in soil and water under agricultural management, while CarboSOIL model is developed as a land evaluation tool to assess the capacity of C sequestration in Mediterranean regions.

Despite the ecological and economic importance of the NEI, studies related to soil C modeling and their simulation under different land-use changes from natural vegetation to plantation systems are scanty. For this reason, there is a strong need to assess the soil C sequestration potential of different plantation systems, with an increase in the plantation age, to evaluate their viability for sustainable land management in comparison with forest land-use.

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Timber Production: An Opportunity for the Tree Growers

Rakabandera Ch Marak[1]
Laishram Sonia Chanu[2]
Nirmala Angom[3]
Ajay Kumar[4]
Dinesh Kumar Meena[2]
1. Amity School of Natural Resources and Sustainable Development, Uttar Pradesh
2. ICFRE-Rain Forest Research Institute, Jorhat
3. Manipur University Canchipur, Imphal
4. Green Credit Cell, ICFRE, Dehradun

Timber production plays a pivotal role in India's economy, serving as a vital resource for various industries and contributing to rural livelihoods, environmental sustainability, and economic development. Timber is the raw materials for various sectors such as construction, furniture manufacturing, and paper production. Over the years, timber production in India has witnessed evolving trends influenced by changing market dynamics, environmental concerns, government policies, and technological advancements. Timber production trends reflect a shift towards sustainable practices and commercialization in the country. Emphasis on plantation forestry, including species like teak, eucalyptus, bamboo, and poplar, aims to meet growing timber demand while conserving natural forests. This shift is further enhanced by private sector engagement, community forestry initiatives, and public-private partnerships, driving investments in timber plantations and value-added wood products. Sustainable practices like agroforestry and community-based forest management are gaining prominence, supported by government programs promoting afforestation and sustainable harvesting. Technological integration, including mechanized equipment and digital inventory systems, enhances efficiency and resource management in timber production. Additionally, the timber industry is diversifying its product range to include engineered wood, pulp, furniture, and biomass energy, opening avenues for innovation and entrepreneurship. These trends signify India's commitment to balancing economic growth with environmental conservation in the timber sector, ensuring long-term sustainability and resource management.

Demand of timber: The estimated demand for timber in India is significant and is projected to continue growing. Demand for raw wood to fulfil various industrial requirements exceeds 100 million m3. Between 1998 and 2010, the need for timber surged from 52 to 95 million m3. Projections indicate that this demand is set to rise substantially, reaching an estimated 213 million m3 by the year 2030.

Supply of Timber: India sources its timber primarily through a combination of imports and domestic production. In 2014, domestic production yielded 50 million m3 of wood logs, while the export value of primary timber products exceeded USD 80 million, as reported by the International Tropical Timber Organization (ITTO) in 2015. According to the Forest Survey of India (FSI) in 2017, the annual yield of timber from agroforestry and Tree Outside Forests (ToF) was estimated at 74.5 million m3, a figure later reported to

have increased to an annual yield of 85.2 million m3 as per the FSI's 2020 data. Furthermore, the yearly availability of timber from government forests was estimated to contribute an additional 2.4-3.0 million cubic meters. Importing approximately 6-7 million m3 further supplements the overall availability of wood for industrial purposes, resulting in a total availability of 83.5 million m3 in 2012. It's noteworthy that the contribution of recycled or reclaimed wood is considered insignificant when evaluating the overall timber availability for industrial purposes.

Gaps in Demand and Supply of Timber: While India holds a prominent position as a leading global producer of tropical logs, it equally ranks among the largest consumers of wood products internationally. Despite being a key player in the production of tropical logs, the country heavily relies on imports due to limitations in domestic supply. In terms of annual timber demand, India reached a substantial 95 million m^3, but the actual production falls significantly short, standing at only 47.37 million m^3. Addressing this discrepancy, the World Bank highlighted a noteworthy challenge in India – a significant imbalance between wood supply and demand. This challenge is particularly evident in the case of fuelwood, where overharvesting surpasses sustainable levels by approximately 139 million m^3 from regulated sources. This emphasizes the critical need for India to strategize and implement sustainable forestry practices to bridge the gap between its substantial timber demand and the actual production levels.

Availability of land for timber production:

Land availability is a crucial factor in enhancing timber production, and its judicious utilization with modern tools and techniques is paramount. In India, the landscape for timber production encompasses various categories of land:

Agricultural Land: India boasts a vast culturable non-forest area of approximately 182 million hectares. Presently, agro-forestry occupies about 25.31 million hectares, accounting for 8.2% of the country's total land area and 14% of the total culturable land. Utilizing agro-forestry practices can further enhance timber production, leveraging existing agricultural land resources.

Forest Land: India's forest cover, as per the Forest Survey of India (FSI) report of 2021, spans 7,13,789 km^2. Open forest cover, moderately dense forest cover, and very dense forest cover constitute 3,07,120 km^2, 3,06,890 km^2, and 99,779 km^2, respectively. Utilizing the vast expanses of open and moderately dense forest areas for plantation can transform them into denser forests, fostering enhanced timber production.

Wasteland: Transforming cultivable wastelands into productive areas through plantation initiatives is vital to alleviate pressure on natural resources. In 2015–16, India's estimated wasteland area stood at 55.76 million hectares, accounting for 16.96% of the total Total Geographical Area (TGA). Approximately 12 million hectares of cultivable wasteland in India, identified by Chand, R. (2023), have the potential to support the country's timber production needs. Notably, dense scrub, waterlogged and marshy land,

sandy areas, degraded pastures/grazing land, and gullied ravine land are the categories where significant changes in land use have been observed.

By leveraging these various categories of land, India can strategically enhance timber production through agro-forestry expansion, forest regeneration efforts, and the reclamation of wastelands. This holistic approach to land utilization underscores the importance of sustainable land management practices in meeting the country's timber production goals while preserving environmental integrity.

Opportunity for tree growers

Tree growers, often referred to as foresters or arborists, are individuals or organizations dedicated to cultivating and managing trees for various purposes. Given the previously outlined demand and supply dynamics in India, it's evident that there exists a significant demand for timber within the country. To meet this demand for timber, it is imperative to substantially increase domestic timber production.

Timber production stands as a significant opportunity for tree growers in India, offering avenues for economic prosperity, environmental sustainability, and rural development. As a country rich in forest resources and with a growing demand for timber-based products, India provides an ideal environment for tree growers to capitalize on this lucrative sector.

To leverage this opportunity, efficient utilization of available resources through strategic planning and contemporary methods is crucial. To empower tree growers in augmenting timber production, we will systematically examine various forestry practices and government policies, schemes, and programs in India. This comprehensive analysis aims to provide a detailed understanding of how these initiatives can be harnessed to optimize timber production and contribute to sustainable forestry practices. By delving into each aspect individually, tree growers can make informed decisions, implement modern techniques, and align their efforts with supportive policies, ensuring a synergistic approach to enhance timber production in India.

Forestry practices for enhancing timber production

Numerous forestry practices for tree plantation have been documented, tested, and evaluated regionally by research organizations and agricultural and forestry universities in our country. By adopting appropriate techniques and practices, tree growers can enhance timber production on their available cultivable land. The following are some popular forestry practices

Agro-forestry: Agro-forestry refers to a land use management system wherein combinations of trees are cultivated around or among crops or pasture. There are many models are available based on the agro-climatic zone which can be adopt by the farms. By promoting agro-forestry plantations, wood-based industries can achieve self-

sufficiency in procuring locally grown timber. It can also enhance the livelihood opportunities of more than 100 million small and marginal farmers across India through multi cropping and additional income streams.

Farm Forestry: Encouraging the farmers to grow fast growing commercial trees onfarm boundaries and in compact blocks in their own field or village land has been a trend to meet the increase demand of the timber. The main motivating forcebehind the success of farm forestry was to grow wood for the market. Farm forestry primarily focus on timber production while agroforestry aims to optimize multiple benefits of trees within agricultural systems.

Block Plantation: It is a method of afforestation where single or multiple species are planted in a designated patch of available land. It is commonly practiced in common lands, government-owned areas, or panchayat lands etc. Block plantation is mainly used to enhance land cover, establish energy plantations, facilitate mass production of timber, fruits, and fodder, establish seed orchards, and conserve germplasm.

Assisted Natural Regeneration (ANR): This approach is an inexpensive and straightforward method for restoring forests by transforming deforested areas with depleted vegetation into thriving forests. Its goal is to speed up natural forest regeneration processes by addressing obstacles like soil degradation, competition from invasive species, and ongoing disturbances such as fires, grazing, and logging, rather than completely replacing them.

Plantation Promotion Policies, Schemes and Programmes in India

The Central and state governments recognize the importance of tree cover and is actively promoting tree plantation through various policies and schemes. Their broad aims are to restore degraded land, meet the demand for timber and fodder, control soil erosion, and provide recreational opportunities, among other objectives. Some of the important central and state government policies and schemes are as follows:

Central Sponsored

CAMPA: The Compensatory Afforestation Fund Management and Planning Authority (CAMPA) is an Act that establishes funds under the public accounts of each State and India. The funds received from user agencies are credited to the CAMPA in relation to penal compensatory afforestation, additional compensatory afforestation, net present value, and any other amounts recovered from these agencies under the Forest (Conservation) Act, 1980.

National Mission for Green India (GIM): One of the eight missions listed in the National Action Plan on Climate Change (NAPCC) is the National Mission for Green India (GIM). The objective is to safeguard, replenish, and improve India's declining forest cover while addressing climate change through a blend of adaptation and mitigation strategies. It takes a comprehensive approach to greening and

concentrates on a variety of ecosystem services, including carbon sequestration as a co-benefit and biodiversity, water, biomass, preservation of mangroves, wetlands, and important habitats. Due to the fact that this mission will be carried out on both public and private lands and that local communities will play a significant part in planning, decision-making, implementation, and monitoring, it has chosen an integrated cross-sectoral strategy.

Tree Plantation in Private Land: 'Tree cultivation in Private Lands' was introduced in the State from 2007–08 to 2011–12 in an effort to promote tree cultivation outside of forests. This is the nation's first endeavor of its type. Block planting, inter-crop planting, and free supply of profitable tree species for planting in the bunds were used to accomplish it. Profitable tree species included teak, casuarina, ailanthus, silver oak, Melia dubia, and others were planted on farmers' properties. 84099 people have benefited from the planting of 5.45 lakh tree seedlings over an area of 1,61,110 acres on farmers' land outside reserve forests. As incentives, Rs. 1625 lakhs were given out.

The National Mission for Sustainable Agriculture (NMSA): This is a flagship program of the Government of India aimed at promoting sustainable agricultural practices across the country. Launched in 2010, NMSA promotes sustainable agricultural practices, including agroforestry, to enhance land productivity and support rural livelihoods.

National Agro-forestry Policy (2014): India's National Agro-forestry Policy is a comprehensive framework of policies aimed at enhancing agricultural livelihoods through the optimisation of agricultural productivity in the context of climate change mitigation. During the World Congress on Agroforestry in Delhi in February 2014, the Indian government unveiled the policy.Adopting an agroforestry policy, India became the world's first country to do so. By combining trees, crops, and cattle on one acre, the policy seeks to increase productivity and maintain the environment. It was developed to combat low agricultural productivity brought on by persistent declines in farmers' land ownership shares, which were brought on by fast population increase and seasonal rainfall-dependent agriculture.

Sub-Mission on Agro-forestry (Har Medh Par Ped) Scheme: This scheme was started in 2016–17 to promote planting trees alongside crops and cropping systems on agricultural land. The goal was to help farmers increase their revenue and improve the resilience and adaptability of their farming systems to changing climate conditions. This scheme provide assistance to farmers through State Govt. for block plantation, nursery development and block plantation of prominent species to improve qualities of fruits bearing tree borne oilseeds, medicinal & aromatic plants, silk & lac rearing host plants, in addition to timber species, so that farmers get early returns.

Van Dhan Yojana: The Ministry of Tribal Affairs and Tribal Co-Operative Marketing Development Federation of India Limited (TRIFED) are the organizations implementing the Van Dhan Scheme. It was introduced on April 14, 2018, and its goal is to increase tribal earnings by adding value to their products.

Nagar Van Yojana (NVY): This scheme was launched in 2020 to create an Nagar Van in urban areas and contribute to the urban forestry. In cities with municipal corporations, municipal councils, municipalities, or urban local bodies (ULBs), the Nagar Van Yojana aims to establish 1000 Nagar Van, or Nagar Vatika, to provide

residents with a wholesome, healthy living environment and thereby support the development of clean, green, healthy, and sustainable cities.

Forest Certification Schemes: Government-endorsed Forest certification schemes such as the Forest Stewardship Council (FSC) and the Programme for the Endorsement of Forest Certification (PEFC) ensure sustainable forest management practices and enhance market access for certified timber products.

Green Credit Programme: The Indian government announced the Green Credit Program (GCP) on October 13, 2023. It is an innovative strategy that relies on a market-based mechanism designed to provide incentives and rewards to people and organizations for their beneficial contributions to the environment. GoI has notified methodology for the tree plantation under green credit programme. Tree plantation based green credit provides opportunities to the entities and individuals for voluntary participation and to earn green credit through afforestation on state owned degraded forest lands.

Promotion of carbon credit market: As climate change worsens, trees offer a natural solution. By absorbing CO_2, they help reduce greenhouse gasses. Carbon credits, tradable permits representing removed CO_2, have emerged. Tree growers can plant trees, register them for certification, and earn credits when the trees mature. These credits are then sold to companies aiming to offset their emissions. This creates income for growers while fighting climate change.

State Sponsored

Janta Van Yojna: This scheme was launched in 1996–1997 in Rajasthan, the Janta Van Yojana seeks to involve VFPMCs and other organizations in work in plantation and forest regions that goes beyond management and conservation. Under the project, VFPMCs, Gram Panchayats, Sainik Kalyan Sangathan, or seasoned NGOs are given five years to handle plantations and protection. On the basis of their performance, payments are given.

Krushi Aranya ProtsahaYojane (KAPY): This scheme was launched by the Karnataka Forest Department in 2011-2012 to increase the tree and forest cover.Through this scheme, farmers can plant seedlings on their farms at a reduced cost. Upon the completion of the first year, farmers receive an incentive of Rs 35, after the second-year ends, Rs 40, and after the third-year ends, Rs 50. To urge farmers to care for the seedlings for a minimum of three years, this is being done.

One Citizen One Tree Scheme: This scheme was initiated by govt. of Meghalaya on June 5th 2019 to plant more than 1 million trees in 306 spring sheds in the state. This scheme is being funded by Union Ministry of environment, forest and climate change under NABARD.

Ama Jangala Yojana: It is a flagship program which was initiated in 2016-2017 by the Govt. of Odisha which is being implemented by the Odisha Forestry Sector Development Society (OFSDS) in JFM mode covering the 7000 Vana Surakhya Samitis

& Eco Development committees. One of the aims of the program is to conserve and restore the degraded forest through restoration initiatives.

Mukhyamantri Vriksh Sampada Yojana (Chief Minister Tree Wealth Scheme): This scheme initiated by the Govt of Chhattisgarh in 2023,Under thisMukhyamantri Vriksh Sampada Yojana (Chief Minister Tree Wealth Scheme) the state government will provide 100 per cent subsidy for tree plantation on up to 5 acres of land, and 50 per cent financial subsidy on more than 5 acres. The government will decide the minimum purchase price for the sale of earmarked tree species.

Mero Rukh Mero Santati: This Scheme was initiated by the Hon'ble Chief Minister Shri P. S. Tamang of Sikkim on 2nd February 2023.This innovative green program Mero Rukh Mero Santati, which aims to honour childbirth by planting trees and deepen the bond between parents, children, and the natural world. Its goal is to plant one hundred trees for each infant born in Sikkim.

Amrit Brikha Andolan: In 2023, the Assam government launched the Amrit Brikha Andolan, a government initiative. Planting one billion seedlings and one crore saplings is the program's goal. On June 8, 2023, the initiative was introduced by Chief Minister Shri Hemanta Biswa Sarma. After planting, the program offers incentives of Rs. 100. By planting one crore saplings, the Amrit Brikshya Andolan hopes to encourage a more sustainable and greener environment in the stateof Assam. Additionally, the effort seeks to encourage people to grow economically valued tree species, which can increase their income and improve the state's tree economy.

Conclusion

There is a growing demand of timber in India and it is huge gap of demand and supply. The forest (government) land contributes only 4%, while non-forest contributes 45% of the total demand for wood-based industries in India. The analysis of timber demand and supply highlights the necessity of enhancing timber production. To cater this opportunity tree grower should raise plantation of timber yielding species in their land. For enhancing the timber production cultivable agriculture land, degraded forest land and cultivable waste land can be utilised by means of various forestry practices like agro-forestry, farm forestry, block plantation, Assisted Natural Regeneration etc. There are several government-sponsored plantation promotion policies, schemes and programs that provide financial assistance to tree growers. Considering the available resources, forestry practices, and governmental support, it can be concluded that tree growers have a huge opportunity. They can achieve success by adopting the right strategies and scientific approaches.

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The Role of Forests in the Hydrological Cycle

Dr. Nibedita Guru
Scientist-C
ICFRE-Rain Forest Research Institute,
Jorhat,78500, India

Introduction

Hydrology and forestry are two distinct fields that are combined in forest hydrology. The goal of hydrology is to comprehend the locations of bodies of water, their circulation, the reasons behind variations in water distribution, their chemical and physical characteristics, and their interactions with living things. Understanding how water behaves in the hydrological cycle is crucial for silviculturalists, Urban planners, and land developers. The intricacy of present-day water issues, like scarcity, pollution, flooding, and erosion, necessitates an understanding of the land use-related source area processes, especially those affecting the soil, atmosphere, and vegetative and plant phases of the hydrological cycle. While forests are primarily made up of trees, a healthy forest also contains various types of plants, soil, water, terrestrial and aquatic creatures, and people who use the forest's resources. Therefore, knowledge of hydrological concepts is just as important to modern forest management as knowledge of soil science, land use planning, and forest science. Water is regarded by ecologists as the element that best characterizes any ecosystem, including the ecosystem of forests. Water uses erosion and deposition to sculpt the physical terrain. It also influences the biological components of the environment through its distribution, quantity, and quality, as well as by its existence or absence. A vital part of ecosystem activities and functioning is the water cycle. In turn, forests are essential to both the water cycle and the quality of the water. In essence, the forest recycles and filters water like a massive sponge. The intersection of rain, snow, and fog with tree leaves. Through evapotranspiration, leaves also return water to the atmosphere. While aiding in soil retention, tree roots draw water out of the soil. Because trees intercept falling precipitation and delay it from reaching the surface, they lessen the impact of rain on the ground. Additionally, the quantity and speed of storm runoff across the land surface are reduced by forests. As a result, more water percolates into the earth, some of which may eventually be used to replenish underlying aquifers. On the other hand, during dry spells, water from artificial aquifers may seep into streams and wetland shelping to maintain their water levels during dry periods. Since fewer human alterations interfere with the water cycle's components, a naturally occurring, expansive forest environment can strengthen and maintain relationships within it. A forested watershed reduces overland runoff and increases infiltration, which helps to control storm flows. Additionally, a forest

maintains stream flow by lowering evaporation (for example, owing to low temperatures in shaded regions). The forest can also contribute to an increase in the recharging of aquifers by allowing more precipitation to seep into the soil rather than quickly flow off the land and into a downslope location. Rainfall is returned to the atmosphere through transpiration and interceptions, which is the primary way that forest ecosystems influence the water cycle. In addition to decreasing the erosive effect of water with coverage, composition, density, crown closure canopy, and other features, vegetation acts as a mechanical barrier to surface flow.

Hydrological cycles

70% of the earth's surface is made up of water, but since we can only see a small section of it, it might be challenging to understand how much water there is in total. Water plays a major influence in weather, thus it may seem unexpected since the seas hold 97.5% of the earth's water, land contains 2.4%, and the atmosphere holds less than 0.001%. More than thirty times as much precipitation falls on Earth each year as can be retained in the atmosphere. The necessity for quick water recycling between the earth's surface and atmosphere is demonstrated by this fact. Fresh water makes up only 2.5% of the entire amount of water, and 76% of that 2.5% is found in mountain glaciers and polar ice caps, where it is inaccessible to humans for daily consumption.

The water transfer cycle, or hydrologic cycle, is a continuous process in the natural world. The hydrologic cycle, which is seen in Fig.1, comprises three major phases: (a) evapotranspiration and evaporation; (b) precipitation; and (c) runoff.

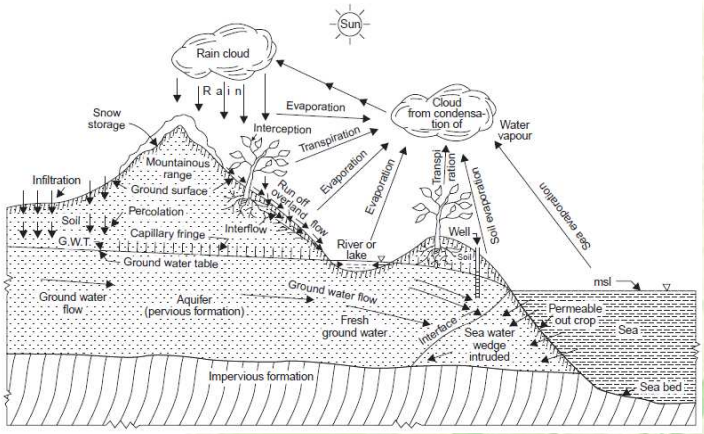

Figure 1: The Hydrological Cycle

Role of forests in the hydrological cycle

The amount of rainfall that forests can store as canopy interception, the amount of transpiration that trees produce, and the high infiltration capabilities that are typically present in wooded soils all contribute to their unique influence on the

water balance. Interception processes are rare in non-vegetated systems, but in closed-canopy vegetated systems, almost all rainfall is intercepted by the vegetation before it reaches the ground. Rainfall with a distinct drop size distribution from the first rainfall is referred to as through fall and descends to the ground following impact or temporary storage in plants. A portion of the water flows down the vegetation's stems. The remaining material evaporates straight off the leaf surfaces when stem flow occurs. Through fall beneath a closed forest canopy behaves differently from rainfall outside of it in terms of drop size distribution and fall height, making it less erosive. More rainfall will reach the soil undisturbed if forests are treated, either by thinning or clear-felling. Variations in the amount of rainfall are intercepted by different tree species. Reduced streamflow yields would result from clear-cutting and regeneration, or bushfire generation, as recovering forests would produce more transpiration. Immediately after vegetation is destroyed, runoff increases. A typical hydrological process occurs in a forested watershed are shown in Fig 2.

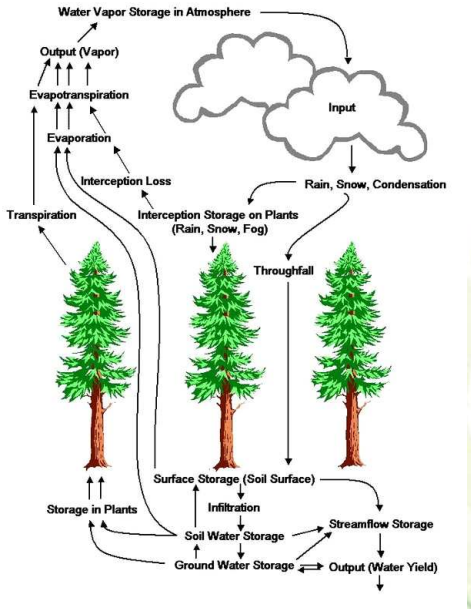

Figure 2: Forest Role in the Hydrological Cycle

From theory to practice: Examining bioplastics' utility in meeting expectation of people

Sonkeshwar Sharma
Scientist -B
ICFRE-Rain Forest Research Institute, Jorhat

Pollution is a serious problem nowadays, especially resulting from mismanagement of waste. Many people tend to use a several products and discard them without proper disposal, which cause significant environmental pollution, and plastic mismanagement is one of them. According to a new Organisation for Economic Co-operation and Development (OECD) report, only 9% of plastic waste is recycled globally, while 22% is mismanaged. It is almost impossible to imagine the life of people without plastic in recent time. People are surrounded by plastic due to its wide applications in daily life. Plastic is an excellent invention for human life, but at the same time, it is also a curse to the environment as it is widely used by people and is not disposed of properly, causing pollution.

Most of the plastics available in the market are conventional plastics. These plastics are mostly produced using fossil fuel resources or petroleum based raw materials. These materials have a finite shelf life on the planet and will eventually almost disappear. As we know, these materials take millions of years to form so they are limited energy resources (Kalair *et al*., 2021). Fossil resources are carbon-related compounds that were cast into the ground millions of years ago from the atmosphere; otherwise, these carbons would have caused significant environmental damage like global warming (Pang *et al*., 2019; Wang and Azam, 2024). Globally, many nations are committed to controlling carbon emissions and reaching net zero, with the Paris Agreement being the prime example. The Paris agreement of 2015 has set a primary objective of limiting the rise in global average temperature to less than 2°C above pre-industrial levels. Additionally, efforts will be made to further limit the temperature increase to 1.5°C above the pre-industrial levels. However, in recent years, world leaders have stressed the need to limit global warming to 1.5°C by the end of this century. Long-term low greenhouse gas emissions development strategies are the best solution to achieve the Paris Agreement targets. Carbon dioxide is the primary greenhouse gas responsible for global warming, and they contribute about 76 percent (Kumar, 2018). Carbon dioxide is a good absorber of heat, absorbing heat coming from the Sun and reflecting it back to Earth, which increases Earth's temperature. The layer of carbon dioxide in the atmosphere acts like a blanket and traps the heat emanating from the earth and reflects it into the earth's atmosphere, causing global warming (Uda *et al*., 2024). Plants can be a valuable resource for researchers working to reduce carbon pollution and slow down global warming.

Plants and animals are made of carbon or carbon-related compounds, and at the end of their lives, they are converted into fossil fuel resources in the Earth's crust at high temperatures and pressure. This process takes many years i.e. fossil fuel resources are nothing but plant and animal-based carbon or carbon-related liquid compounds. These compounds are cast into the earth's crust by nature in the shape of fossil materials. Thereby carbon is sequestered from the environment and stored in the Earth's crust as fossil resources (Kalair *et al*., 2021). Many industries require these resources raw materials, and therefore they are extracted through mining. Due to mining, carbon again comes into the environment in various value-added forms, conventional plastics being one of them (Arutyunov and Lisichkin,2017). Conventional plastics are derived from finite resources and pose significant environmental hazards, researchers are actively exploring alternative options, among which bioplastics prominently feature. A comprehensive understanding of its nature is imperative before drawing any conclusions. With researchers fervently seeking alternatives to conventional plastics, the spotlight now rests on bioplastics as a beacon of hope.

Bioplastic is a type of plastic that is primarily produced from sustainable resources, thereby reducing reliance on non-renewable resources like fossil fuels (Singh and Verma,2020). Raw materials include vegetable fats and oils, wooden waste such as wood chips, sawdust, corn starch, straw, recycled food waste, etc. All these are mostly plant based raw materials and are reproducible. Although animal-based raw materials are also used to make bioplastics, the emphasis in this article is on plant-based raw materials (Salazar Sandoval et al., 2024).Plants are an excellent source of a variety of organic substances, including cellulose, hemicellulose, starch, lignin, and other molecules that are used as primary precursors for bioplastics (Brodin *et al.,* 2017).Plants are good carbon absorbers and absorb carbon as carbon dioxide. The well-known photosynthesis process describes how atmospheric carbon is taken up by plants in the form of carbon dioxide and transformed into organic compounds like glucose (Bhatia et al., 2019).

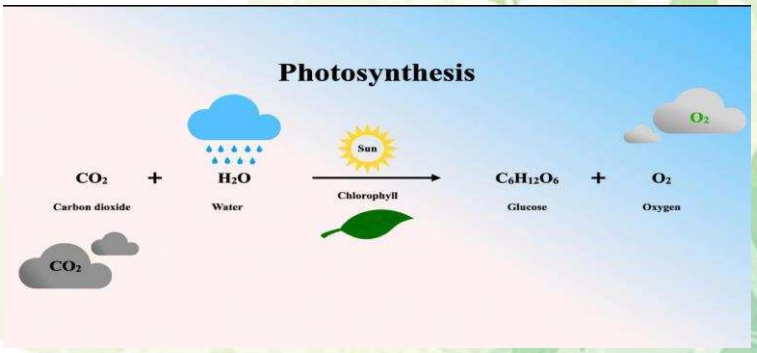

Figure 1: Primary and secondary metabolic pathway precursors are produced during plants' photosynthesis, where carbon is absorbed as carbon dioxide.

Glucose is a precursor reactant for plant primary and secondary metabolic processes. Carbon is stored in plants in different forms like starch, cellulose, hemicellulose etc. These molecules are the end and intermediate products of the primary and secondary metabolic processes of plants. Examples of these molecules include polylactic acid, which is used as a basic ingredient to create bioplastics (Peng *et al*., 2024). Once these bioplastics are used by the consumer and finally thrown into the environment, carbon is produced and again this carbon is consumed by the plants in the form of carbon dioxide, so it is a cyclic process, which is good for a sustainable ecosystem. It brings the linear economy (fossil fuel-based economy) to the green circular economy (renewable resource-based economy).

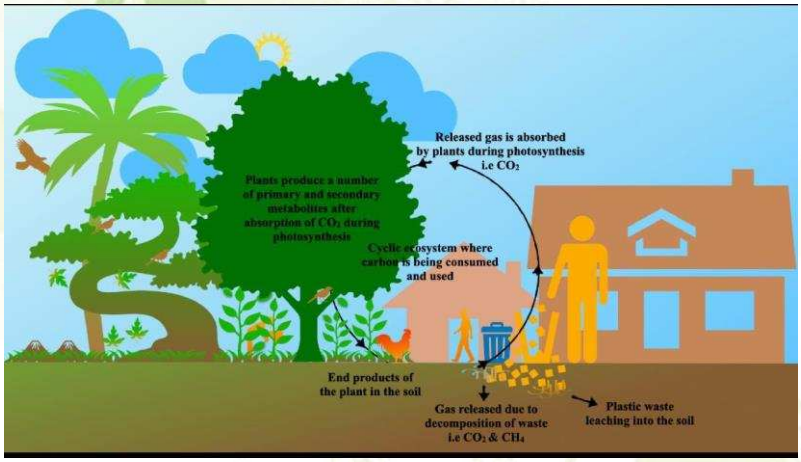

Figure 2: Green circular economy operates in a sustainable environment.

Navigating the complexity, the biodegradability of bioplastics emerges as a significant concern. Despite common misconceptions, bioplastics do possess biodegradable properties. Yet, the critical challenge lies in determining the extent to which they can degrade. Concerns exist regarding the potential environmental impact of any leftover waste or refuse. The end product of many bioplastics are micro and nano plastics, which are even more dangerous to the environment (Shruti and Kutralam-Muniasamy, 2019).Bioplastics are biodegradable under certain industrial conditions and depend on various parameters such as the type of monomer, relative humidity, temperature and pH (Folino et al., 2020).At present people know that its natural biodegradability into valuable biomass is not completely assured. Thus, one issue-namely, how to lessen reliance on fossil fuel resources as a source of basic materials and transition it to a green circular economy, has been somewhat resolved. However, since it is not entirely natural compostable, the ultimate outcome is still in doubt in terms of environmental

impact. Despite this, if researchers guarantee natural biodegradability, the product's usefulness and longevity will be weakened. Therefore, there is still a lot of scope for researcher to make bioplastics a viable option to conventional plastics.

Although there are many bioplastics on the market made from polyhydroxyalkanoates and polylactic acid variants, they are not completely biodegradable in soil under normal conditions. But at industrial level, their biodegradability can be assured. A product's biodegradability raises the environmental worth of that product, but at the same time compromises its usefulness in terms of durability. Reconciling the conflicting and inversely proportional characteristics of bioplastics' durability and biodegradability is an important task for researchers. Single-use plastics, which are primarily made from fossil resources, have historically been banned in many countries. If bioplastics share some of the shortcomings of conventional plastics with a few modifications, they could fill a large gap that currently exists in the market.

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Amentotaxus assamica D. K. Ferguson: an endemic and endangered Gymnosperm of Eastern Himalaya

Dr. Tajum Doni
Scientist-B
Forest Ecology and Climate Change Division
ICFRE-Rain Forest Research Institute, Jorhat

Amentotaxus Pilg. is a small genus of gymnosperms represented globally by six accepted species (Farjon, 2010). The species of the genus have a restricted natural distribution and are found mainly in southern China (including Taiwan), Vietnam, Loas, small portions of the Eastern Himalayas, and parts of Indo-China. *Amentotaxus* Pilg. generally are evergreen trees or large shrubs that form the understory of moist sub-montane and montane semi-deciduous or evergreen forests (Gao *et al*., 2017). Of the six recognized *Amentotaxus* species, five are currently considered threatened at national or global level, primarily due to various anthropogenic disturbances (Wang & Xie, 2004; IUCN, 2023).

Fig: Morphological features of *Amentotaxus assamica* (left to right) **A.** Stem of mature tree. **B.** Dorsal view of leaves. **C.** Ripen fruits (*Source*: Genius Teron, EDGE Fellow)

Amentotaxus assamica D. K. Ferguson commonly known as Assam catkin yew is the only species of the genus *Amentotaxus* reported in India. The species is endemic to the Eastern Himalayas and is distributed in small pockets mainly in the Dallei valley of Lohit district and Turoo forest in Papum Pare districts of Arunachal Pradesh, India, at an altitude range of 1600-2100 m (Das *et al*., 2008; Lyngdoh *et al*., 2020). The species is currently assessed as Endangered by the IUCN (IUCN, 2023). In its natural habitat, *Amentotaxus assamica* forms an important associated species of *Rhodendrons* spp., *Castanopsis* spp, *Quercus lamellose*, *Magnolia* spp., *Acer* spp. etc. in the temperate broadleaved forest of Arunachal Pradesh (Haridasan, 1988).

Locally, the species is valued for its mature timber which is widely harvested for use as pillars and posts in house construction and firewood (Gajurel *et al*., 2006).

In addition, the recent study has revealed the potential of its bark as a source of cost-effective and environmental friendly nanoparticles with antibacterial, antidiabetic and antifungal properties that have potential application in pharmaceutical and medicinal industries (Bharali *et al*., 2019). Nevertheless, in the recent time the natural habitat of *Amentotaxus assamica* is facing enormous anthropogenic threats in the form of shifting cultivation, forest clearance for large cardamom plantations, road construction and timber harvesting, resulted in the rapid decline in its natural population (Das *et al*., 2008; Lyngdoh *et al*., 2020; IUCN, 2023). Furthermore, the poor natural regeneration status of the species adds to the additional decline in the population (Gajurel *et al*, 2006).

The rapid decline in the population of India's lone *Amentotaxus* species necessitates an urgent conservation effort to protect both its natural habitat and population. Conservation efforts such as standardisation of propagation techniques, species reintroduction programmes, and raising awareness among local communities in long run may pave a way in reviving and stablising the ever decreasing natural population of the endemic and endangered *Amentotaxus assamica*.

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ATMA- An approach towards dissemination of technologies for the development of Agricultural and Allied Sector

Triveni Kalita
Block Technology Manager,
Khowang Development Block, CSS-ATMA

Agricultural Technology Management Agency shortly termed as ATMA is a Farmer Oriented Programme to improvise various skills not only in Agricultural field but also in different other Allied Departments like Animal Husbandry, Fishery and Sericulture. The main aim of this scheme is to impart technical knowledge on a broad-based scale to the farmers in getting fruitful results and better income.

This Scheme focuses on the following key extension reforms:

• Encouraging multi-agency extension strategies involving Public/ Private Extension Service Providers.

• Ensuring an integrated, broad-based extension delivery mechanism consistent with farming system approach with a focus on bottom-up planning process.

• Adopting group approach to extension in line with the identified needs and requirements of the farmers in the form of CIGs & FIGs and consolidate them as Farmers Producer Organizations.

• Facilitating convergence of farmer centric programmes in planning, execution and implementation.

• Addressing gender concerns by mobilizing farm women into groups and providing training to them.

Funding:

The scheme is supported by the Central Government. The funding pattern is 90% by the Central Government and 10% by the State Government. The 10% state's share constitutes of cash contribution of the State, Beneficiary contribution or the contribution of other Non- Government Organization.

Activities taken up by ATMA:

1. **Farmers Training Programme:** Farmer Training Programmes are scheduled within District, within State and outside State, either in the Extension Education Institutes or in the Research Stations for benefit of the farmers.



2. **Organization of Demonstration Plots:** Demonstration on various aspects of Agriculture and Allied sector indicating the gaps identified in that areas and strategies to be adopted to overcome the said deficit.





3. **Field Demonstrations & Front-Line Demonstrations:** Institute like Krishi Vigyan Kendra, Soil Testing Lab are entrusted with the job of organizing field demonstration & Front-Line demonstrations duly providing the required budget by ATMA.



4. **Transfer of Technology:** This is being done from farmer to Farmer to create awareness among the farmers on the newly introduced technologies in Agricultural and Allied field.
5. **Exposure Visit:** These visits are planned within the District, within the State as well as outside the State to the place where improved Agricultural practices and other activities are taken up by the Allied Departments.

6. **Capacity Building & Skill Development Programmes:** Several farmers group like CIG, FIG, Farmer Cooperative Societies & Allied Institutions are selected for imparting Capacity Building & Skill Development training programmes.



7. **Farmer Scientist Interactions:** Scientists and Extension Staff participate in these Programmes and hold discussions with the farmers on various problems faced by them at field level as well as marketing sides.
8. **Farm School:** Farm Schools are preferably organised in a cluster approach so as to have a demonstrable impact. It serves as a mechanism for Farmer-To-Farmer Extension.
9. **Organization of Exhibitions & Kisan Melas:** Exhibitions & Kisan Melas are organized in the villages to create awareness among the farmers on the latest technology in the field of Agriculture and Allied sectors.
10. **Information Dissemination:** Any new technology needs to be made available at the door step of the farmers through various media. In particular printing of Pamphlets & Literature in the local language are being taken up by ATMA.
11. **Technology through Electronic Media & IT Network:** Progressive farmers and Extension Staffs are to be provided information on the latest field level technologies through electronic media and information technology network.
12. **Agriculture Clinics & Agriculture Business Centres:** The National Institute of Agricultural Extension Management (MANAGE), Rajendranagar, Hyderabad is taking up training programmes to Agriculture Graduates for establishing Agriculture Clinics & Agriculture Business Centres for transfer of technology and various extension activities the farmers have to adopt at field level. The centres are identified by ATMA and are provided with necessary technical assistance.

ATMA is a society key stakeholders involved in Agricultural activities for Sustainable Agricultural development. It is a focal point for integrating Research and Extension activities and decentralizing day to day management of the public Agricultural Technology System.

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Success story on
SUBSTITUTE JIGAT FOR AGARBATTI INDUSTRY

Dr. Prosanta Hazarika
ACTO
ICFRE- Rain Forest Research Institute, Jorhat

Introduction

Asia Pacific region is the major producer and consumer of agarbattis. It is a traditional product. Mostly, people burn Agarbatti for religious purposes. It is considered as an essential item in every households and places of worship. India is the topmost Agarbatti producing country of the world, meeting both domestic and international demand. Among the Indian states Karnataka leads in producing Agarbatti. Agarbatti production by South Indian States comprises 35% of domestic market, while West-India produces 30%; North-India produces 18% & East India accounts for 17%. Apart from domestic consumption, India supplies more than half of the world's incense sticks requirement. Some of the major agarbatti importing countries are the USA, UAE, and Nigeria. India exports agarbattis worth about Rs 900 crore a year to nearly 150 countries. The industry employs nearly 4 Lakhs individuals, 80% of them women.

Importance of Jigat for Agarbatti Industry

Agarbatti production units need five different materials: (1) Bamboo sticks (for the central core of the Agarbatti); (2) Charcoal powder; (3) Jigat powder (Adhesive); (4) Perfume/ Fragrance and (5) Packaging material.

Jigat is one of the important materials used as binder of filler materials that are rolled on the bamboo sticks to obtain agarbatti. Originally, Jigat (adhesive material) was extracted from the glutinous bark of *Persea macrantha* (Syn. *Machilus macrantha*) in Central India. Later on the bark of *Litsea glutinosa* (Syn. *Litsea chinensis*) and *Canarium strictum* emerged as the substitutes of the Jigat. Apart from these, resin from *Ailanthus triphysa*, *Acacia farnesiana*, *Myroxylon toluifera*, *Boswellia serrata*, glues and gum from *Acacia nilotica* etc. are also utilized as adhesive materials by Agarbatti industry.

However, increasing demand for Jigat due to the expansion of agarbatti industry in India has led to unsystematic felling of Jigat producing trees of the evergreen and semi- evergreen forests of Western Ghats and Northeast India. The agarbatti industry of India has been in search of substitute to Jigat powder or binding agent with unique burning properties. Presently, the industries import more than 50 percent of Jigat (Joss powder) or its raw materials from Malaysia, Vietnam and Thailand.

Substitutes for Jigat

ICFRE-Rain Forest Research institute, Jorhat, Assam has identified suitable plant based natural adhesives as substitute of Jigat for incense sticks industry.

Twenty five (25) plant species were identified as suitable to be used as substitute Jigat (SJ). These plant species were distributed in different states of the Northeast India. They are- *Abroma augsta* (Gorakhia korai), *Actinodaphne angustifolia* (Sati sali), *Actinodaphne obovata* (Petarichawa), *Actinodaphne lawsoni*, *Altingia excelsa* (Jutili), *Cinnamomum tamala* (Pat cheni), *Cinnamomum zeylenicum* (Dalcheni), *Ipomoea batatas* (mitha alu), *Corchorus olitorius* (Mora pat), *Corchrus capsularis* (Tita mora), *Colocasia macrorrhizos* (Man kachu), *Grewia multiflora* (Kukut suta), *Glychenea* sp, *Hibiscus rosa-sinensis* (Joba Phul), *Homalomena aromatica* (Gandha kachu), *Impatiens glandulifera* (Koriya bijal), *Litsea cubaba* (Mejankari), *Litsea sebifera* (Neluka), *Manihot esculenta* (Simolu Alu), *Morus alba* (Nuni), *Pouzolgia indica* (Borali bokuwa), *Sida cordifolia* (Soru Sonboriyal), *Sida rhombifolia* (Sonboriyal), *Pilea scripta* and *Urena lobota* (Bor Honborolua).

Production of Substitute Jigat

For the purpose of conservation of the species that are harvested destruction for jigat production and also for import substitution, the project on identification of substitute plants was conceived and executed. The technology involves harvesting of plant parts such as bark, leaves, seeds, flowers, whole plant and tender shoots; processing, drying, grinding, sieving, quality assessment and storage.

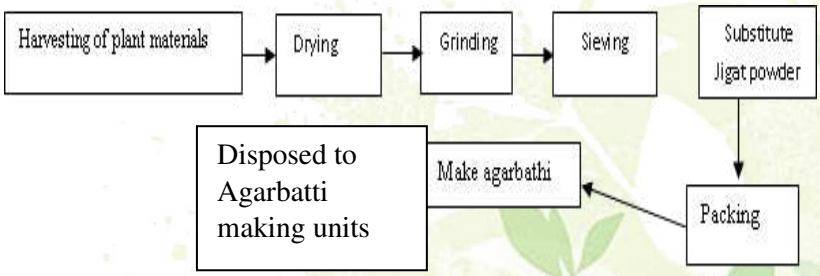

Fig- 1 Diagrammatic sketch of entire process involves in preparation of substitute Jigat.

Quality Assessment and standardizing the ratio of preparation Masala with substitute Jigat

Substitute Jigat (SJ) can be prepared from individual species or combinations by mixing two of more plant materials. The suitable ratio of SJ: filler ratio i.e. 1:3 for hand rolled agarbatti and 1:4 for machine make agarbatti.The powdered form of plant materials is now termed as substitute Jigat (SJ). The SJ obtained from a plant species can be use alone as substitute Jigat or in combinations mixing with filler materials to prepare 'Masala'. The masala is used to roll over the bamboo sticks

for making incense sticks (agarbatti). Charcoal powder and saw dusts are known as filer materials. As of now the market price of per kg Jigat/ Joss powder cost in India is Rs. 40-50 + 5 % GST. It is also evaluated that on an average 10 kg fresh leaves or tender plant parts gives 2.5 -3.0 kg dry powder (SJ) and 10 kg fresh bark in turn gives 3.0-4.0 kg of substitute Jigat. This is an encouraging result for the entrepreneurs for setting up of Jigat production unit by cultivating the SJ yielding plants at commercial scale.

Precautions

Precautions also need to be taken while harvesting the plant materials not to be mounded for long time. Suitable arrangement need to be taken for drying them immediately after harvesting. The temperature should be maintained 60ºC at the time of drying in Hot Air Oven to avoid any change in the physico-chemical property of the plant materials. This is done to retain the exact properties of the plant materials as they possess in raw forms. Therefore, never set the temperature of Hot air oven beyond 60ºC while drying materials. We can use oven to dry prepared agarbatti at 60ºC for 2-3 hrs. Drying plant materials can be stored in suitable dry chamber or shed for a short period of time. However, regular monitoring is required to ensure that no infestation of insect or fungal growth is occurred. Therefore, to avoid this problem it is required to be grinded in to Jigat powder and immediate packaging. After packaging there is very little chance for deteroriation of Jigat quality for a year or two.

Production of Jigat in commercial scale

The plant species such as *Alocasia macrorrhizos* (Man Kasu), *Corchorus capsularis* (Tita Mora), *Corchorus olitorious* (Mitha mora) *Hibiscus rosa sinensis* (Joba Phul), *Homalomena aromatica* (Gandh Kasu), *Ipomoea batatas* (Ronga alu), *Manihot esculenta* Crantz. and *Morus alba* can be cultivated annually for production of 'Substitute Jigat'. Tender branch tips of *Hibiscus rosa sinensis*, *Manihot esculenta*, *Morus alba* and entire aerial part of Ipomoea batatas, rhizome of *Alocasia macrorrhizos*, *Homalomena aromatica* and one month field grown Corchorus capsularis and *Corchorus olitorious* are suitable for making SJ. Commercial cultivation of *Corchorus capsularis*, *Corchorus olitorious* is also practiced by a large numbers of farmers for jute production. The plant tips above two species being wasted while harvested by farmers as of no use. These plant tips can also be used for making SJ. It is also observed that at the time of harvest of tubers of Ipomoea batatas, the aerial part of the plant is being wasted. As such value addition can be done by collecting this above ground biomass for making of SJ very effectively. Moreover, three more plants *i.e. Hibiscus rosa sinensis*, *Manihot esculenta* and *Morus alba* are very common in homesteads of this region. Farming of *Hibiscus rosa sinensis* and *Morus alba* can very effectively be done for Jigat production as the tea growers done for tea cultivation. Cultivation of both the

plant species as tea crop and pruning/ plucking of tender tips may be viable alternative of self-employment and to make a new enterprise similar to tea industry.

We do not have the agro techniques for other wild annual and perennial herbs such as *Glychenea* sp, *Impatiens glandulifera*, *Pilea rotundinucula*, *Pouzolzia indica*, *Sida cordifolia*, *Sida rhombifolia* and *Urena lobata*. At present, knowledge also scanty regarding the regeneration dynamics, resilience to harvest, data on the density and size-class distribution for allowing them sustainable harvesting from wild sources. However, this information regarding suitability of these plant species may be useful to the entrepreneurs to collect plant species from that area which are being cleared for cultivation and other purposes.

The Jigat prepared from these plant species are having good binding ability (stickiness) and produce textured agarbatti with better burning ability, burning time & odor in comparison to commercial Jigat. Most importantly, agarbattis produced by using SJ are low fragrant absorbent and during storage no moisture absorb, no loss of stickiness and no fungal growth observed. They can be stored in open in a dry room condition up to 1 year and suitable transportation.

Keeping in view the significance of Jigat in making of incense sticks in Agarbatti industry these 'Substitute Jigat' from 25 plant species may contribute to fulfill substantial local demand. It has potential to produce in rural sector and therefore this manual will directly helps the farmers and entrepreneurs. The technology for making substitute Jigat and agarbatti making is also transferred to SHGs and local entrepreneurs for making agarbatti using alternative Jigat.

Fig.1 Testing of prepared Jigat samples suitability for Agarbatti industries

Dr P Hazarika demonstrated jigat production

Making hand rolled agarbatti at Piyong

Dr P Hazarika demonstrated agarbatti making using SJ at Piyong, Arunachal Pradesh

A part of trainees in Pathar Gaon Circle, Namsai District, Arunachal Pradesh

Fig. 2 Technology transfer training for making agarbatti using substitute Jigat at Piyong, Namsai district, Arunachal Pradesh

Dr P Hazarika demonstrated agarbatti making

Dr P Hazarika demonstrated agarbatti making

Dr P Hazarika demonstrated agarbatti making

Trainees making agarmatti in Parhat Gaon

Fig. 3 Technology transfer training for making agarbatti using substitute Jigat at Pathar Gaon, Namsai district, Arunachal Pradesh

হস্তনির্মিত ধূপকাঠী প্রস্তুতকৰণ কৌশলৰ প্ৰশিক্ষণ

যোৰহাট, ৩০ অক্টোবৰ ঃ যোৰহাটৰ চাৰিগাঁৱৰ কলাখোৱাত যোৱা ২৭ অক্টোবৰত 'ছ'চাইটি ফৰ প্ৰম'টিং ইক'ফ্ৰেণ্ডলি এনভাইৰনমেণ্ট (বন্ধুভাবাপন্ন পৰিবেশ বিকাশ সমিতি), অসম'ৰ সৌজন্যত হস্তনির্মিত ধূপকাঠী প্রস্তুতকৰণ কৌশলৰ এক প্রশিক্ষণ অনুষ্ঠিত হয়। কলাখোৱা অঞ্চলৰ মহিলাসকলৰ সহযোগত অনুষ্ঠিত অনুষ্ঠানটোত ছ'চাইটিৰ সভাপতি ড° তপন চন্দ্র দত্তক ৰিণ্টু দত্ত হাজৰিকাই আৰু সমল ব্যক্তি বর্ষাৰণ্য গবেষণা কেন্দ্রৰ বিজ্ঞানী ড° প্রশান্ত হাজৰিকাক জুৰি দত্ত ভৰালীয়ে সম্বর্ধনা জনায়। অনুষ্ঠানটোত ছ'চাইটিৰ সম্পাদিকা অনুৰাধা দেৱীয়ে আদৰণী ভাষণ আগবঢ়ায়। ড° কুন্তলা নেওগ বৰুৱাই প্রশিক্ষণ কার্যসূচীৰ উদ্দেশ্য ব্যাখ্যা কৰে

আৰু ড° ইন্দ্রাণী পাটগিৰী বৰাই সমল ব্যক্তি ড° প্রশান্ত হাজৰিকাৰ পৰিচয় প্রশিক্ষার্থীসকলক অবগত কৰে। ছ'চাইটিৰ সভাপতি ড° তপন চন্দ্র দত্তই উদ্বোধনী ভাষণ আগবঢ়ায়। ড° প্রশান্ত হাজৰিকাই দৃশ্য-শ্রাব্য মাধ্যমৰ যোগেদি প্রশিক্ষার্থীসকলক মনোমোহা ভাষণ আগবঢ়োৱাৰ লগতে হাতে-কামে ধূপকাঠী প্রস্তুতকৰণৰ প্রশিক্ষণ দিয়ে। প্রশিক্ষণৰ শেষত প্রশিক্ষার্থীসকলৰ প্রত্যেককে ছ'চাইটিৰ তৰফৰ পৰা মানপত্র আগবঢ়োৱা হয়। অনুষ্ঠানটোত শলাগৰ শৰাই আগবঢ়ায় বিজয় বৰদলৈয়ে।

Fig.4 Technology transfer training for making agarbatti using substitute Jigat at Kolakhowa Gaon, Jorhat district, Assam

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Plant tissue culture: a simple technique in a special way

Bebija L. Singha, Shikhamoni Borah and Chayanika Gogoi
ICFRE-Rain Forest Research Institute, Jorhat

Plant Tissue Culture

Plant Tissue Culture, also known as micropropagation or *in vitro* culture, involves the growth and maintenance of cells, tissues, or organs in a controlled environment outside of their natural habitat. Tissue culture techniques typically utilizes aseptic conditions and a nutrient-rich medium to nurture cells and facilitate their growth and development. This technique typically begins with the selection of an explant - a piece of plant tissue such as a stem, leaf, or root. The explant is sterilized to remove any surface contaminants and then placed onto a nutrient-rich medium containing essential nutrients, vitamins, and plant growth regulators. Under carefully controlled conditions of temperature, light, and humidity, the explant begins to develop into a whole plant through processes such as cell division, differentiation, and organogenesis. Plant tissue culture offers numerous benefits and applications, ranging from the mass production of genetically identical plants (clones) to the propagation of rare or endangered species, and many more. This technique has revolutionized agriculture as well as the conservation of plant biodiversity. Although plant tissue culture comes with many benefits, it also possesses various challenges and limitations.

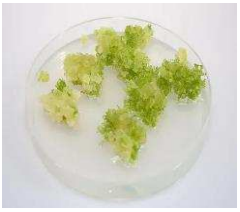

Figure1: Callus culture

Applications and benefits of plant tissue culture:

This technique finds diverse applications in various fields such as agriculture, medicine, and research. Its benefits include:

- **Rapid Multiplication:** Plant tissue culture allows for the rapid multiplication of plant cells, leading to the production of large quantities of genetically identical plants within a short timeframe.
- **Genetic Manipulation:** Tissue culture provides a platform for genetic manipulation, enabling the introduction of desirable traits or the removal of undesirable ones through techniques such as gene editing and transformation.
- **Disease Elimination:** Tissue culture techniques can help eliminate pathogens and diseases from plant tissues, producing disease-free planting materials crucial for maintaining healthy crops and conserving plant biodiversity.
- **Continuous production:** Tissue culture enables year-round production of plants regardless of seasonal constraints, offering a continuous supply of planting materials and reducing dependency on external factors such as weather conditions.

• **Conservation of Rare Species:** Plant tissue culture plays a vital role in conserving rare and endangered plant species by preserving their genetic diversity and facilitating their propagation in controlled environments, thus helping to prevent their extinction.

Techniques employed in plant tissue culture:

Based on the various plant parts, including leaves, stems, roots, buds, and meristems parts utilized in the process, tissue culture methods are categorized into different types:

(i) **Callus culture:** A callus is an undifferentiated mass of cells which has the potential to grow into any part of the plants. Under the right conditions, the callus can turn into shoot primordia and eventually form somatic embryos.

(ii) **Protoplast culture:** A protoplast is a plant cell lacking a cell wall. In this approach, the plant cell's wall is eliminated using mechanical or enzymatic methods. After purification, the cell wall is regenerated under controlled conditions, and the protoplasts are transferred to appropriate media for growing into complete plants. This method is primarily employed to create hybrid or genetically modified plants.

The techniques generally used to grow protoplasts are:

- Hanging-drop cultures
- Micro culture chambers
- Soft agars matrix

(iii) **Embryo culture:** It involves isolating and cultivating immature or mature plant embryos to support the growth of complete plants. Instead of sterilizing the embryos individually, the organ (such as ovule, seed, or fruit) from which they are extracted is sterilized and utilized in the process. In certain plants, seed dormancy, caused by mechanical resistance or chemical inhibitors, hinders plant growth and development. Therefore, in such scenarios, embryos are isolated from the plant and cultured in an artificial environment to grow into viable seedlings.

(iv) **Ovary culture:** It involves placing fertilized or unfertilized ovaries from plant species in a suitable environment to grow into complete plants.

(v) **Cell Suspension culture:** It can be obtained either directly from the explant or callus. In this method, tissues are transferred to liquid media and continuously agitated to obtain a suspension of single cells.

The obtained single cells can be cultured using many techniques, such as:

- Filter paper raft nurse tissue technique
- Microchamber technique
- Microdrop method
- Bergmann's plating technique

(vi) **Axillary bud culture:** A technique in plant tissue culture where axillary buds, found in the leaf axils, are isolated and cultured to propagate new plants. This method is widely used for the rapid multiplication of plants with desirable traits, such as disease resistance or high yield. Axillary bud culture allows for the production of a large number of genetically identical plants within a short period, making it an efficient method for plant propagation and breeding. Additionally, it enables the preservation and conservation of rare or endangered plant species.

Bamboo axillary bud culture in ICFRE-RFRI, Jorhat:
In the tissue culture laboratory of RFRI Jorhat, *in vitro* culture of 6 different species of bamboo were attempted and become successful in producing numbers of clones of the selected genotypes.

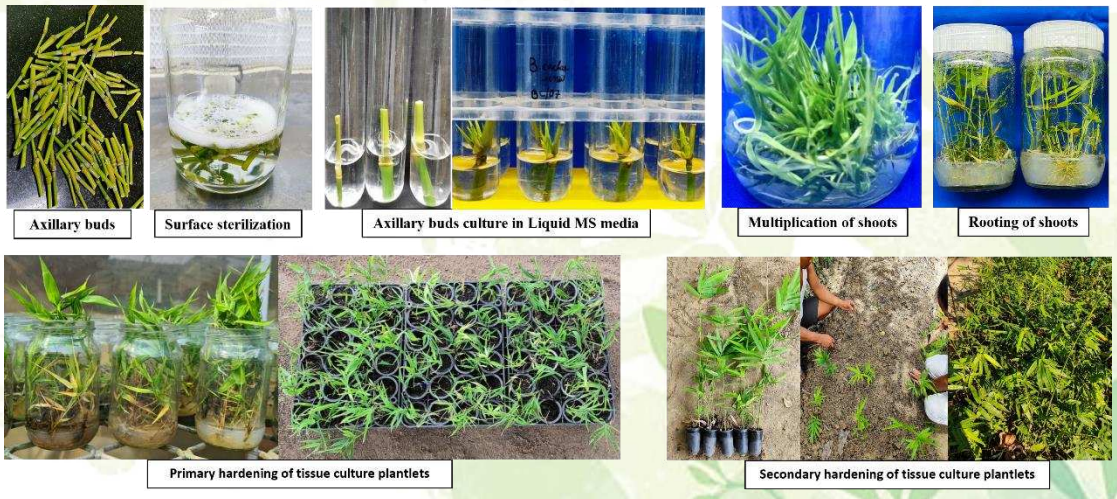

Figure 2: Images of bamboo axillary bud culture

Challenges encountered in plant tissue culture:

• **Contamination:** Maintaining sterile conditions throughout the tissue culture process is critical, as even a single fungal or bacterial contaminant can ruin an entire culture. Contamination control requires rigorous sterilization techniques and a carefully controlled laboratory environment.

- **Cost and Infrastructure:** Establishing and maintaining a tissue culture laboratory requires a vast amount of money for equipment, supplies and skilled staff.
- **Skill and expertise:** Achieving consistent and good outcomes in tissue culture requires expertise in aseptic techniques and tissue culture methodologies which can be challenging for the beginners to acquire in a short amount of time.
- **Ensuring Safety:** Maintaining safety while working under the Laminar Airflow is crucial among the challenges of tissue culture.

Conclusion:

Plant tissue culture stands as a powerful technique with wide-ranging applications in various fields such as agriculture, medicine, and research. Its ability to facilitate rapid multiplication, genetic manipulation, disease elimination, and year-round production makes it invaluable in addressing global challenges related to food security, human health, and conservation. Despite facing challenges such as contamination and high costs, the benefits offered by tissue culture far outweigh its drawbacks. As technology advances and techniques improve, tissue culture continues to play a crucial role in advancing scientific knowledge, enhancing crop productivity, and preserving biodiversity. It is a simple yet powerful technique with wide-ranging applications. While its benefits are significant, it's important to acknowledge that it can be challenging to master and implement effectively. With more practice and continued improvement, however, tissue culture has great potential and contribute to sustainable development.

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Wild Edible Mushrooms

Dr. Girish Gogoi
Senior Technical Officer
Forest Ecology & Climate Change Division
ICFRE-Rain Forest Research Institute, Jorhat

A total of about 1200 mushrooms species have been reported from India, out of these 300 to 315 species are found edible. It was reported that about 283 wild edible mushrooms have been consumed by most of the tribes of India from ancient time as a major component of food. Oyster mushroom, White button mushroom, Paddy straw mushroom and Milky mushroom are widely cultivated in India and easily available in the market. Mushrooms are rich in proteins, fibres, minerals, and vitamins. In Assam most the species of *Termitomyces* spp. and Oyster mushrooms are found in the forests, homestead, and tea gardens.

The origin of the genus *Termitomyces* is derived from Termites that means these mushrooms are always found associated with termite's mounds. A root like structure called pseudorhiza is originated from the base of the mushroom, extends to a certain depth into the soil and attached with the termite's mounds. This is one of the most significant identifying characters of *Termitomyces* spp.. This is the genus in the world where the largest number of edible mushroom species are found and almost all species are edible. Photographs of a few species *Termitomyces* spp. found in the homegarden/grassland where heap of dead and decaying wood, branches, twigs, leaves etc. are buried under the soil which is good for inhabitant of termites. In this mushrooms if the stripe/stalk is split longitudinally it splits like jute fibre and the upper side of the cape is pointed. The skin of the cape can be removed from the margin with the help of fingers like skin.

Termitomyces clypeatus

Termitomyces indicus

Macrolepiota albuminosa

Termitomyces microcarpus

Termitomyces heimii

There are 38 species of Oyster mushrooms among them *Pleurotus ostroatus, P. flabinatus, P. florida, P. sajor-caju* etc. are commercially cultivated are cultivated in Assam or India. Photographs of some wild edible Oyster mushrooms are given below.

Lentinus sajor-caju

Lentinus squamosus

Mushroom poisoning is very a common news in the daily newspapers of Assam or Northeast India during the month of April to August every year. A few members or the whole family died due to consumption of poisonous mushrooms. Some of the news of mushroom poisoning in Assam are given below. A total of three members including a two years old child of a family of Golaghat district died due to consumption of poisonous mushroom on 9th April, 2023. In the year 2022 thirty-five people of upper Assam admitted in Dibrugarh Medical college due to mushroom poisoning and 16 people died out of them. In Charaideo district four people, three of them belongs to same family died on 5th May, 2020 due to mushroom poisoning. Two people of a family of Demow, Sibsagar district died and five others fell sick due to consumption of poisonous mushrooms on 5th March, 2019. Due to consumption of poisonous mushrooms 8 people including women and children died in Tinsukia district in the year 2014. In Upper Assam 30 people died due to mushroom poisoning in 2004. After the incident a team of scientists from AAU, Jorhat investigated the case of mushroom poisoning in the year 2004 and they found that *Amanita phalloides* was the poisonous mushrooms they used to consume. The Govt. of Assam conducted awareness programmes in the interior villages and tea garden of Upper Assam, not to consume the wild mushrooms without proper identification. Despite of these awareness programmes the cases of mushroom poisoning were repeated in Upper Assam.

After mushroom poisoning the community people don't have any indigenous curative measure and they are immediately send to hospital for recovery. These tragic incidents happen in Upper Assam due to misidentification of wild edible mushrooms and lack of proper indigenous knowledge transfer from generation to generation. The aged people of villagers and tea garden used to identify and collect the wild edible mushrooms in the morning when the mushrooms remained fresh. They don't collect the edible mushrooms in the afternoon or evening because the mushrooms get collapsed and they think that these collapsed mushrooms get contaminated which become poisonous. Some people used to cook the collected mushrooms along with brinjal, if the mushrooms turn black they don't consume it. They think that it is a poisonous mushroom which reacts with brinjal and turns it black.

Author is not inspiring the readers of this article to consume wild edible mushrooms, but trying to give some ideas about a few wild edible mushrooms found in Upper Assam.

Orchids: The Beauty of Nature

Protul Hazarika[1] and Bishakha Hazarika[2]

1. *ACTO, ICFRE-Rain Forest Research Institute, Jorhat, Assam*
2. *PhD Scholar, ICFRE-Rain Forest Research Institute, Jorhat, Assam*

Orchidaceae is the second largest family of flowering plants and distributed in a wide ecological range of habitats with maximum concentration in high and humid tropical and sub tropical areas. In India orchids are distributed in the Himalayan region with its maximum abundance in North East India, Western Ghats, Deccan Plateau and Andaman and Nicobar Islands. North East India comprises of 900 species of 165 genera, representing 72.8% of orchids in India. Assam houses about 398 species and 10 infraspecific taxa belonging to 101 genera, out of which 121 species under 48 genera are terrestrial and 277 taxa under 53 genera are epiphytic. Orchids are considered most highly evolved for floral specialization and diversified plant group. The flowers of orchids are well known for their uniqueness in shape, size, scent and colour are exquisitely attractive; normally remain fresh for a longer period. Orchids are ornamental because of their increasingly beautiful flowers of variant colours and shapes with long shelf life. Many shapes attributed to orchid flowers based on which many common names are given to them like Dove orchids (*Peristeria elata*), moth orchids (*Phalanopsis*), slipper orchid *(Paphiopedilum*), dancing lady (*Oncidium*), and bee orchid (*Ophrys)*. Although orchids belong to one of the largest families, they are one of the most threatened plants on this globe. This is because of their highly specialised lifecycle, dependency on pollinators for pollination, lack of food reserve in their seeds, reliance on microrrhizal fungi for their seed germination, ornamental and therapeutic value. The tribal people of North eastern hill region use wild orchids for a variety of medicine as orchids are rich in alkaloids, flavonoids, glycosides, and other phytochemical like *Aerides multiflora, Arundina graminifolia, Dendrobium densiflorum, Dendrobium jenkinsii, Phaius trankervilleae, Rhynchostylis retusa etc.*

Orchids can reproduce in two ways, sexually by seeds and asexually by vegetative propagation. Orchid uses a wide variety of complex, highly specialised method to attract insect for pollination like nectar, deception to attract male bee by resembling as female of that species. Orchids generally propagate asexually by offshoots or keiki, and by pseudobulbes. An offshoot or keiki are small plantlet that are developed at the base of mother plants or along the stem in some species of *Dendrobium*, *Phalanopsis*. The division of pseudobulbs and rhizome of overgrown orchids is divided into two or more separate plants is another vegetative propagating process.

Orchid species in North Eastern India are endangered due to their natural habitat destruction like clearing of forest for agricultural practices, timber operations, road construction, and hydropower dam construction. The epiphytic orchids are facing maximum danger due to cutting of host trees which serves as substrate, and also due to increasing aridity of climate as a result of deforestation. The indigenous forests are dwindling rapidly for road construction and many epiphytic species are in danger of losing their natural habitat. Habitat destruction is the primary threat to rare, endangered and threatened orchid species in India.

Fig. 1: Destruction of orchids due to deforestation

Orchidaceae family is one of the most unique, diversified and beautiful flowering plants in the world along with many economical and medicinal properties. North Eastern region of India is rich in orchid diversity, but now they are facing serious threat due to environmental factors and climate change many of the orchids are now included in the RET list of IUCN and will face extinction. Department of Forest and wildlife together with local people should hold hands to protect the vast genetic diversity of orchids in the region.

Few Rare Orchids of North East India -

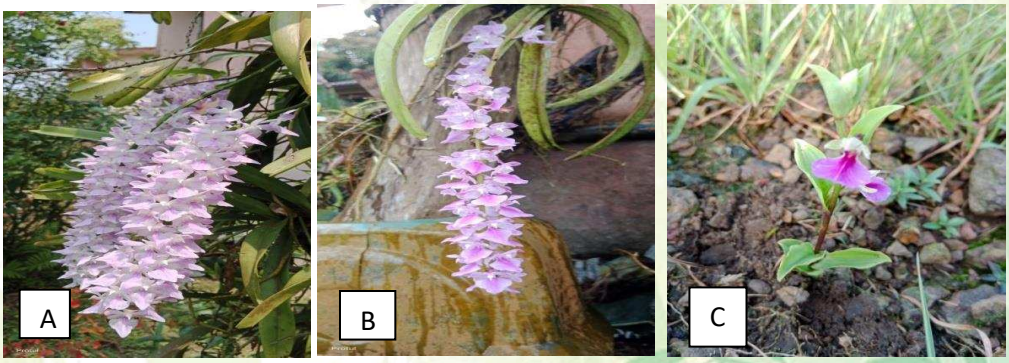

Fig. 2 : A. *Aerides rosea*, B. *Aerides multiflora* and C. *Brachycorythis iantha*

Fig. 3: D. *Bulbophyllum affine* E. *Calanthe masuka* F. *Coelogyne cristata*, G. *Dendrobium bensoneae*, H. *D. densiflorum*, I. *D. fermeri*, J. *D fimbriatium* K. *D. jenkinsii*, L. *D. Lituiflorum*, M. *D. Moschatum*, N. *D. Nobile*, and O. *D. transparens*

Fig. 4 : P. *Habenaria acuife*, Q. *Phalanopsis lobbi*, R. *Phalanopsis Mannii,* S. *Phaius trankervilleae* T. *Pholidota articulate*, U. *Rananthera imschootiana*, V. *Rhynchostylis retusa*, W. *Tainia latifolia*, X. *Vanda cristata* , Y. *Vanda ampullaceal,* Z. *Vanda bicolour* and AA. *Vanda stangeana*

Bio-ethanol: Hope for Bamboo Growers of NE Region

Kumud Borah
Senior Technical Officer
ICFRE-Rain Forest Research Institute, Jorhat, Assam

Bamboo is a versatile, multipurpose, non-wood forest produce, which plays an important role in human welfare since time immemorial. It is one of the world's largest natural and renewable resources. At present, there are about 75 genera and 1250 species in the world. India has a bamboo bearing area of 15 million ha (FSI, 2021) with about 136 species under 23 genera. North East India comprises of 34.5% of bamboo area, with about 90 species belonging to 15 genera. The bamboo stock in terms of green weight of the sound culms (both green and dry) is 84.99 million tons in the northeast, which is 45% of the growing stock in India.

Bamboo is used extensively in Northeast India mainly for constructions, especially in rural areas, and as a food material. It is also closely woven into the culture of the people and finds use in various cultural events and traditional practices. A large number of bamboo handicrafts are made in all the States. Till date more than 1500 uses of bamboos are documented. It is used in pulp and paper industries, as wood substitute, building and construction, households and crafts, cottage industries, as food, in packing industry and as a source of material for handicraft, agricultural implements and carts, toys, musical instruments, fences, animal fodders etc. Shoots of some species are also used as vegetable and also for making pickles. Bamboo plywoods are also in demand for their look. The industrial application of bamboo is not widespread throughout the region, but is confined to pockets.

Bamboo is a perennial woody grass, which is distributed widely in the world. Bamboo belongs to the family Poaceae. Bamboo has been found to be capable of generating commercial quantities of ethanol and methane gas. Bamboo is a special fuel source whether it is mature or immature, dry or has high moisture content. It is considered as a candidate lingo-cellulosic substrate for bio-ethanol production (Ming-xiong, *et al.*, 2014). The conversion of bamboo into bio-ethanol, bio-methane, natural food, flavonoids and functional Xylo-oligosaccharides production has been done in many countries. Studies are conducted by many researchers to produce ethanol from bamboo as a potential source of bio-gas (Kobayashi *et.al*, 2004) and as an alternative renewable and sustainable fuel resource (Zhang *et al.*,2007). Bamboo possesses a growth rate higher than most forest trees and consists of very high holo-cellulose content of its dry base (Sun et al 2011). These characteristics of bamboo make it a viable biofuel source for production of bio-ethanol (Farrell *et al.*, 2006).

Bamboo is extensively grown and propagated in National Mission programmes to meet industrial and rural demands. At the national level around 13.47 million tons of bamboo are harvested annually and annual yield varies from 1 to 3 tonnes per ha. The most commercially important species are *Bambusa balcooa, B. tulda, B. nutans, B. pallida, B. bambos, B. polymorpha*, *Dendrocalamus brandisii, D. hamiltonii, D. giganteus D. strictus, Melocanna baccifera, Ochlandra travancorica, Schizostachyum dullooa, Thyrsostachys oliveri etc.* During the last 15-20 years, bamboo has developed as an exceptionally valuable and often superior substitute for wood. The North-Eastern Himalayan region harbors more than 45% of the Indian Bamboo resource. In this region bamboo is one of the important minor forest produce that assist in subsistence income of tribal population to a great extent covering areas like food, shelter, handicrafts, furniture, medicines etc. Bamboo constitutes one of the most important renewable natural resources of India and hence its judicious utilization to tap maximum potential is necessary.

About 85% of petroleum oil need of India is being met through imports. Indian economy is growing steadily resulting in rapid increase of vehicular population and demand for transportation fuels. Government of India already mandated blending of ethanol in gasoline by 10% to reduce the oil import from 2021-22. Bureau of Indian Standards is finalizing the specification of 20% ethanol blended gasoline for use as vehicular fuel. Studies have been conducted to know the current and future scenario of Indian transportation, petroleum oil and bio-fuel sectors including global progress on utilization of ethanol as an alternative transportation fuel in spark ignition vehicles. It has been found that the gasoline demand is around 44 billion litres by the year 2020 and India has a potential to produce ethanol to the tune of 30 billion litres per annum in addition to existing capacity (Sakthivel, *et al.*, 2018). Apart from augmenting production of first generation ethanol, the second generation lingo-cellulosic ethanol and thermo-chemical conversion of carbon rich agricultural/petroleum residues are seen as alternative option. The potential of such alternative feed stocks and ethanol conversion technologies need to be exploited to increase ethanol availability for blending. Bamboo is a potential and interesting feedstock for advanced bio-ethanol production due to its natural abundance, fast growth, perennial nature and low management requirements. The urgency for development of sustainable liquid biofuel in the transport sector is recognized globally due to concerns regarding energy security, oil price volatility and environmental pollution. Numaligarh Refinery Limited, Assam has taken a step forward by establishing a joint venture, Assam Bio-Refinery Pvt. Limited (ABRPL) to build and operate the first of its kind Bio Refinery in India which would generate renewable green fuel, bio-ethanol, other valuable chemicals and green power from bamboo biomass. Compared to other feedstock, bamboo biomass has a relatively high cellulose and low lignin content which makes it suitable for bio-ethanol production. The

production of bio-ethanol from bamboo is a viable energy resource which is renewable and sustainable and both mature and immature shoots of bamboo can be used for ethanol production and also production of methane gas. Bio-ethanol shall be produced from bamboo as feedstock by using pioneering 3G Formicobio technology by a Finnish technology provider, M/s Chempolis Oy with other valuable chemical and bio-coal. Chempolis Oy is the technology provider who develops and provides technology solution for biomass, biofuel, alcohol, palm oil and chemical industries worldwide and Fortum 3BV is an energy producing company from Finland. The Bio-Refinery will produce 49000 ton of Bio-ethanol, 19000 ton of Furfural , 11000 ton Acetic acid 31000 ton Food grade liquid CO2 and Bio-coal by using around 500000 ton bamboo per annum. Marketing of bamboos in Assam, there is no well developed organized marketing channel. The growers and the middlemen are mainly involved in the supply of bamboos across Northeast. The commercially important bamboos are sold in local markets and are mostly used for traditional applications. One of the major users of bamboos is pulp and paper industry. But due to some reasons, the market of this industry has collapsed in Assam.

Assam Bio-Refinery Pvt. Limited will consumed 500000 ton bamboo per year for production of bio-ethanol which is going to be a game changer in terms of additional revenue generation for the bamboo farmers of Northeast regions through sustainable cultivation, extraction and transportation of bamboo.

Clump of *Bambusa tulda*

View of ABPRL Refinery, Numaligarh

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Costaceae or Spiral Ginger plant family: An Overview

Ankur Jyoti Saikia[1]
Prodip Kumar Hazarika[2]
1. Technical Assistant, ICFRE-Rain Forest Research Institute, Jorhat, Assam
2. Senior Technical Officer, ICFRE-Rain Forest Research Institute, Jorhat, Assam

Medicinal and Aromatic Plants (MAP) are natural stores of bio-active and therapeutic components that play an important role in the prevention of various diseases and improvement of human health. We all are aware that most of the modern synthetic drugs widely used today are associated with some undesirable side effects and can sometimes lead to other patho-physiological complications. Hence in this context, traditional herbal medicines have an important role as compared to modern medicines.

Taxonomic affiliations are also important factors that influence people while selecting plants for medicinal purposes (*viz.*- tradition, efficacy, availability and ease of collection). Interestingly, certain plant classes have greater species diversity and a higher proportion of medicinally useful species. Leguminaceae, Lamiaceae, Euphorbiaceae, Apocynaceae, Malvaceae, Apiaceae, and Ranunculaceae were listed as the most medicinally important plant families globally in a report presented by the Royal Botanic Gardens, Kew. But, given the accumulation of information about the usefulness of medicinal plants prevalent among different ethnic and geographical affiliations, a consensus has not yet been achieved. New plant families are being created through classification related research and re-analysis of facts. Monocot angiosperms have an important family, in this context *i.e.* Costaceae.

Costaceae, known as the Costus family or spiral gingers, are a group of pan-tropical monocotyledonous angiosperms. It comes under the Zingiberales plant category and contains about 143 known species in 8 genera (*viz.*, *Monocostus, Dimerocostus, Taepinocheilos, Paracostus, Chamaecostus, Hellenia, Cheilocostus* and *Costus*). Plants of this plant group are native to the tropical climates of Asia, Africa, Central America and South America. The plants of this family are mainly herbaceous, perennial, rhizomatous and odourless. In some species, the stem is twisted in a coiled form; while the leaves are arranged in a spiral form on the stem; leaf sheath closed; hairs multicellular, unlined, unbranched; stamens are formed by fusion of five sterile stamens and stamens are pubescent.

Details of some important plants of this family are given below.

a) *Cheilocostus speciosus* (J. Koenig) C.D. Specht. (*Costus speciosus* J. Koenig) (Plate: a)

Vernacular Name: *Jomlakhuti* (Assamese)

A perennial herbaceous species commonly found in tropical and subtropical regions of Asia, Africa, and America. In the studies conducted so far, it has been described as a source of sesquiterpenes, sterols, saponins, phenolics, benzoquinone, fatty acids and alkaloids. The compounds present in its rhizome exhibit anti-bacterial, anti-fungal, analgesic, anti-hyperglycemic, anti-hyperlipidemic, anti-pyretic, antioxidant as well as anti-fertility and estrogenic activities.

Plate: *Costus* species conserved in the Zingiberales Herbal Garden of the ICFRE-Rain Forest Research Institute. a: *Costus erythrophyllus*, b: *Cheilocostus speciosus*, c: *Costus pictus*

b) *Costus pictus* D. Don (Plate: b) and *Costus igneus* Nak.
These species, popularly known as *'Insulin Plant'* due to its anti-diabetic properties, has been recognized for its ethnomedicinal uses in Africa, America, West Indies, China, Sri Lanka and India. , It is a valuable source of various industrially important bioactive chemical components such as *diosgenin*, *dioscin*, *costusosides*, *eremanthin*. The plant reveals a wide range of important bioactivities including anti-diabetic, antioxidant, anti-cancer, hepato-protective and many other activities.

c) *Costus woodsonii* Mass
Is a perennial herb that grows to about 1–2 meters tall and has a clumping growth habit. Studies have proven the antioxidant and antimicrobial activity of the methanolic extracts of different parts of this plant (leaves, rhizomes and leaves). Alkaloids like *rutin* and *quercetin-3-galactoside* have been found in the leaves, *epicatechin* in the inflorescence and *dioscin* in the rhizome.

d) *Costus afer* Ker-Gawl
It is a perennial, relatively small bushy plant which is usually found in moist and dense forests and on river banks; which grows up to 4 meters tall and bears white and yellow flowers.

e) *Costus erythrophyllus* Loss. (Plate: c)
It is a tropical rhizomatous perennial plant, naturally available in Colombia, Ecuador, Peru and northern Brazil; which is usually about 1 meter high and is adorned with waxy leaves, the upper part of which is deep green while lower part is purple.

From the facts presented in this article, it becomes clear that the plant species found under this angiospermic monocot group are used either for medicinal purposes or as ornamental ones. Although it was essential to discuss the distribution, taxonomic description, medicinal chemistry, biological potential, health applications of these species as well as molecular, genetic and biotechnological advances; keeping in mind the length of this article, such an attempt has been avoided. Therefore, researchers are requested to focus on advanced biotechnological approaches such as genetic diversity assessment, implementation of conservation strategies, ecosystem monitoring. Unfortunately, due to overexploitation and other anthropogenic pressures, some of these species are listed as near threatened; this list can also be long. Hence, aspects such as study of molecular diversity, discovery of elite genotype(s)/chemotype(s), *in-vitro* propagation methods, etc. are necessary to ensure conservation and sustainable use. This will be a key area of future research to determine the industrial feasibility of this production.

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Mental Stress and its Prevention

Shahnin Akhtar Islam

MTS, ICFRE-Rain Forest Research Institute, Jorhat

In present day-to-day life, mental stress is an important issue for human beings. Stress can be defined as a feeling of physical or emotional tensions which can stem from various sources such as work pressure, financial concerns, relationship issues, health problems, and societal expectations resulting in various battles they face silently. The constant bombardment of information through technology and media can also contribute to feelings of overwhelm and anxiety. Competition for superiority, meeting deadlines, managing multiple responsibilities, balancing personal and professional lives, fear of failure or the pressure to excel, can intensify stress levels. Additionally, Social interactions, while often enjoyable, can also be a source of stress due to the need to navigate complex dynamics and meet social expectations. Also the quickly changed living style of modern life leaves little time for relaxation and self-care leading to exhaustion and burnout. Current global landscape, with its uncertainties and challenges, has added new layers of stress. Concerns about health, safety, and the future can weigh heavily on the mind which directly effect in increasing stress as well as on health. Moreover, the current global landscape, with its uncertainties and challenges have added new layers of stress. Concerns about health, safety and the future can weigh heavily on the mind, exacerbating existing stressors.

Mental stress can significantly impact our quality of life, including:

Physical health like headaches, muscle tension, fatigue and sleep disturbances. Emotional well-being which can contribute to anxiety, irritability, mood swings, frustrations, depression and trauma. Social relationships can strain due to increased irritability or withdrawal from social activities. Stress due to behavioral changes of one individual might affect another leading to unhealthy coping mechanisms such as overeating, substance abuse, avoidance behaviors, gender discrimination etc.

Cognitive Function in where stress may diminish concentration, memory and decision-making abilities.

Living a stress-free life is not always necessary for a person to live as stress is a natural part of life and can sometimes even be beneficial in motivating us to learn many lessons or adapt to challenges. We should learn to manage every difficult situation and maintain a healthy balance between stress and happiness through

various strategies like prioritizing tasks based on importance and urgency; setting realistic deadlines and allocate specific time slots for tasks.; avoiding over commitment ; incorporating short breaks throughout the day to recharge (few minutes of deep breathing or stretching exercises); staying organized in workplace as well as in personal life; taking a balanced diet, regular exercise and prioritizing sufficient sleep; setting clear boundaries between work and personal life; sharing concerns as well as asking for support and guidance when needed from colleagues, friends or professionals; practicing mindfulness meditation, yoga to help alleviate stress and promote relaxation. Focusing on the aspects of work that we enjoy and find meaningful to reduce mental stress.

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Potential of Carbon Sequestration from tree plantations

Miss Monpi Hazarika[1] & Mrs. Ritashree Khanikar[2]
1. MTS, ICFRE-Rain Forest Research Institute, Jorhat
2. Technical Officer, ICFRE-Rain Forest Research Institute, Jorhat

The term "carbon sequestration" is used to describe both natural and deliberate process in which CO_2 is either removed from the atmosphere from emission sources or stored in the ocean, terrestrial environments (vegetation, soil and sediments) and geological formations. The natural mechanisms that comprise the global "carbon cycle" preserved a nearly equilibrium between the absorption of CO_2 and its release back into the atmosphere prior to the start of human-caused CO_2 emissions. Both directly and indirectly, nearly half of the terrestrial biological carbon cycle is already being impacted by human activities. If this cycle were properly managed, it could be a major contribution to the mitigation of CO_2. It is generally recognized that the environment is adversely affected by a rise in carbon dioxide in the atmosphere. Increased CO_2 concentrations in the atmosphere act as a catalyst for the greenhouse effect, thereby enhances global temperatures. As a result, there is melting of polar ice, sea level rise, climate change etc. Because of their rapid development, soil and vegetation contain greater amounts of carbon when atmospheric CO_2 levels are slightly raised. But at higher atmospheric CO_2 concentrations, growth is restricted because photosynthesis reaches its maximum and soil respiration rate rises with warmth, further raising atmospheric CO_2 levels. Afforestation and Reforestation (A/R) as an effective way to reduce atmospheric carbon by building up terrestrial carbon stocks and to produce Certified Emission Reduction (CERs). It has been reported that improved management of land may lead to a significant quantity of soil carbon being stored and may provide a way to reduce the concentration of CO_2 in the atmosphere. Under Kyoto Protocol, governments may adopt forest management techniques, such as rotation time frame, to help them fulfilling their obligations to reduce greenhouse gas emissions. In this regard, the carbon sequestration potential of tree species becomes significant. It changes depending upon soil type, climate, species, and management. Plantations which retain carbon have a major impact on the global carbon sink. Young plantations can sequester relatively larger quantities of carbon while a mature plantation can act as a reservoir. Number of researchers has made different research work related to high yield of carbon content from tea plants, bamboo plants, tree plants, forest trees, rubber plantation, oil palm plantation etc. which shows that the potential for conserving Carbon is so high that it may be considered as a good practice to be included in future mitigation agreements under a revised Clean Development Mechanism. It is also reported that urban green spaces are likely to

have a wider impact per area of tree canopy cover in comparison to other nonurban forests due to faster growth rates and increased proportions of large trees.

Tea (*Camellia sinensis* (L.) O. Kuntze) is grown under a canopy of trees which provide partial shade. It is grown widely in countries of Asia, Africa and the Near East and plays a vital role for earnings and food security for a large fraction of population in these countries. Tea is a major and important economic crop in China, and large proportions of tea plantations are expanding into areas originally occupied by forests. A significant amount of carbon is stored and sequestered in biomass components by the tea agroforestry system. The main source of Carbon stock and sequestration in the system is shade trees. The species composition and biomass distribution of shade trees Carbon emphasized how important a function each component plays in the system for Carbon stock and sequestration. The soil of the tea garden, the shrubs, and the shade tree altogether provide a very strong factor that should be investigated as a carbon sink for mitigating climate change.

India has abundant resources and species diversity of bamboo. About 25% of bamboo species of the world are found in India, distributed widely in almost all states. They are particularly abundant in the Western Ghats and North-east India. In terms of sustainability and carbon fixing capacity, Bamboo has several advantages over tree species. Bamboo is one of the most productive and fastest growing plants on the planet and also recorded as a valuable sink for carbon storage. Bhattacharyya *et al*., (2009) observed that carbon sequestration is one of the important mitigation strategy to cope with the impacts of climate change by reducing the atmospheric concentration of carbon dioxide emissions. The carbon sequestration potential increases with the age of bamboo plantation, more the age of bamboo plantation higher value of carbon sequestration potential, whereas lower value of carbon sequestration potential was recorded in fallow land. The potential of other bamboo species add as a valuable resource for climate change mitigation strategies, and future research studies.

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Checklist of the Avifauna of Rain Forest Research Institute, Jorhat, India

Avishek Sarkar[1], R. S. C. Jayaraj[2], Temjensola Jamir[1], Pradeepen Rai[3]

1. PhD Scholar, *ICFRE-Rain Forest Research Institute, Jorhat*
2. IFS (Retd.) *Ex-PCCF, Andaman and Nicobar Islands; Chairman, UT Environment Impact Assessment Authority, A&N Islands*
3. *T.A., ICFRE-Rain Forest Research Institute, Jorhat*

Two years of opportunistic observation (2018-2020) was used to prepare a checklist of the avifaunal diversity at Rain Forest Research Institute, Jorhat. A total of 65 species belonging to 12 orders and 37 families were recorded from the study area during the period. A campus bird count conducted in the year 2010 reported 34 bird species. Even though there have been a considerable number of additions to the checklist, 3 species were not recorded during the latter period, which might be due to changes in land use in and around the campus. The botanical garden was found to be the most species rich (41 species), while a single tree of *Albizia procera* was found to be visited by 31 different species across the duration of the study.

Introduction

The Indian subcontinent is rich in biodiversity, from a diverse floral population to a rich mammalian, reptilian, amphibian and avifaunal biodiversity. There are four Biodiversity hotspots across the country, the Himalayas, Indo-Burma region, Western Ghats and Sundaland, which indicates the volatile situation of biodiversity across the country. India is reported to have about 14% (1317) of the 9600 avian species identified worldwide (**1**). During a study assessing 867 species, 72 of them were reported to be endemic (**2**), pointing towards the need of proper conservation measures to manage their populations. Assam is the gateway to North-Eastern states of India and falls within the Indo-Burma biodiversity hotspot. The entire North-Eastern region is rich in biodiversity and avian diversity is also a prominent part of it. Of the 818 bird species found across the North-East India, Assam was found to harbor the maximum number of species (689), roughly 52% of the total number of species found in the country (**3**). Studies conducted during 2008-2010 (**4**) at Hollangapar Gibbon WLS found 232 different species of birds while that conducted during 2016-2018 (**5**) at Jhanjimukh- Kokilamukh IBA wetland assemblage found 205 species. The current study was undertaken at the Rain Forest Research Institute campus, located just a few kilometers from these study areas in Jorhat (Assam) to know about the avifaunal diversity in relation to the other two diverse areas.

Study area

Located in Jorhat district of Assam, Rain Forest Research Institute was established in the year 1988. It works under the Indian Council of Forestry Research and Education of the Ministry of Environment, Forests and Climate Change, Government of India. About 12 kilometres away from Jorhat town, it is situated in Sotai (26^{0}46'53.61"N &94^{0}17'29.55"E). Spread across approximately74-acre area, the institute has a lush green campus. The campus is strategically situated, with Hollongapar Gibbon WLS towards the east, Brahmaputra river towards the North and Jhanjimukh-Kokilamukh IBA running west to east along NH-37 from Kokilamukh (Jorhat) to Jhanji (Sibsagar). The institute's botanical garden,located on the other side of the road, adds to the abundant tree cover. The institute is focused in implementing forestry research, and thus carry out many plantation trials within the campus.

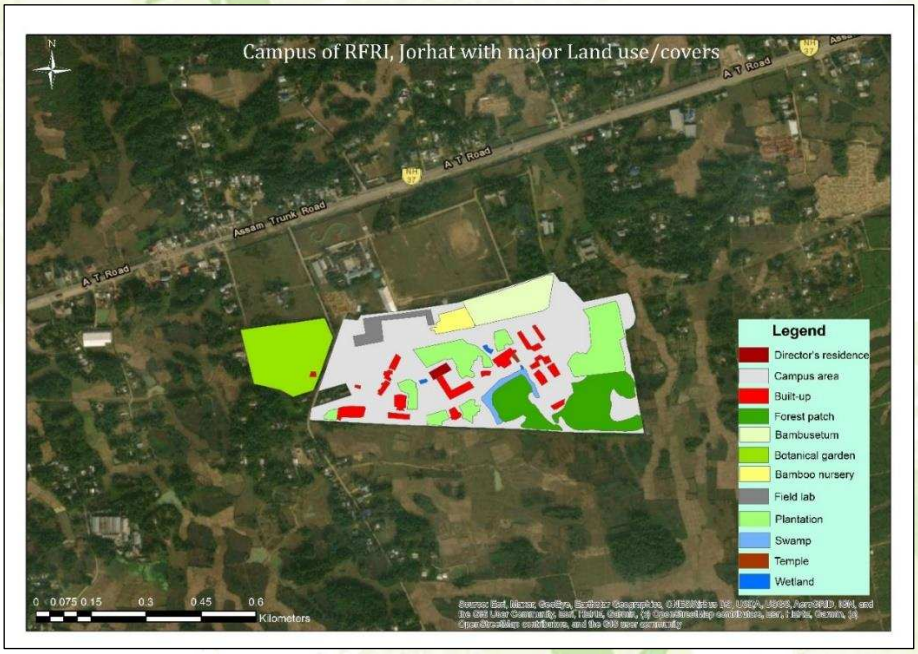


Fig. 1 Study area map [Layout of RFRI Campus with major Land use/covers]

Plantations within the campus include Agar, Persian Lilac, different Bamboo species, Poplus species, Noni, *Dipterocarpus rhetosus*, Rattan etc. Owing to the rich floral diversity, the campus has a rich faunal diversity as well. Some of the notable fauna includes Monocled cobra, Banded krait, Checkered and Striped keelback, Bronze back tree snake, Common bengal monitor, Indian leopard, Rhesus macaque and Assamese macaque. The average ambient temperature is 23^{0}C with average rainfall of about 204cm.

Methodology

The study was carried out for a period of 2 years, from September 2018 to July 2020. The bird counts were carried out using Opportunistic observations. The bird

walks, when conducted, were done from 5am till 7.30am and from 4pm till 5pm during winters, while during summer, the evening observations were made from 4.30pm till 5.30 pm. Any bird missed during the bird walks and sighted during any other time of the day were recorded as well. Observations were done using Canon Powershot SX 540-HS, which was used for identifying and taking pictures of the species encountered for easy reference and documentation. Photographs of most of the species was obtained, and identified as per the taxonomic keys of Ali and Ripley (**6**) and Grimmett et al. (**7**). All the birds were categorized in the checklist as per State of India's *Birds, 2020 (**2**)*.

Results

During the survey period, a total of 63 species of birds were recorded from the study area. The Botanical Garden area was found to hold the highest diversity of avifauna with 41 species recorded from this location during the study, followed by the area around Shiv temple with 35 species. The Rattan plantation area within the Botanical garden was found to harbor the least number of species, with only 6 species recorded from there. The maximum number of species were recorded of the order Passeriformes, with 30 species, followed by Coraciiformes with 6 and Anseriformes and Psittaciformes with 5 species each. There were 4 species from the orders Ciconiiformes and Cuculiformes while 3 species were from Columbiformes. Bucerotiformes, Gruiformes, Piciformes and Strigiformes contributed with 1 species from each of these orders.

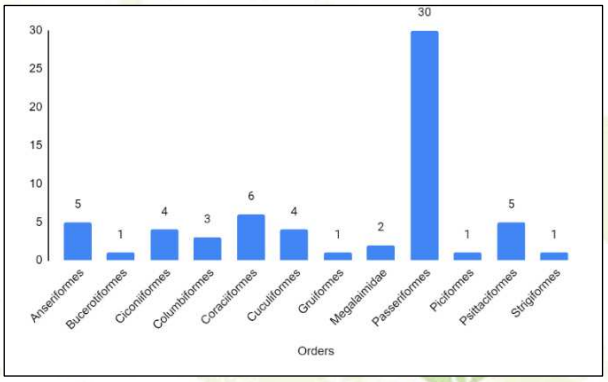


Figure 2. Graph showing Order of avifauna within the campus

Sl. No.	English Name	*Scientific name*	IUCN Category	WPA Schedule	Migratory status	Location
Order Anseriformes						
Family Ardeidae						
1	Cattle egret	*Bubulcus ibis*	L.C.	IV	R	At tilled land
2	Indian pond heron	*Ardeolagrayii*	L.C.	IV	R	Swamps and water bodies across the campus
3	Intermediate egret	*Ardea intermedia*	L.C.	IV	R	New plantation sites across

						campus, Botanical garden
4	Purple heron	*Ardea purpurea*	L.C.	IV	R	Opposite temple
Family Anatidae						
5	Lesser whistling duck	*Dendrocygnajavaniva*	L.C.	IV	R	Wetlands across the campus
Order Bucerotiformes						
Family Upupidae						
6	Common hoopoe	*Upupa epops*	L.C.	IV	R	Near auditorium and Type-II quarters
Order Ciconiiformes						
Family Charadriidae						
7	Red wattled lapwing	*Vanellus indicus*	L.C.	IV	R	Newly excavated areas
Family Ciconiidae						
8	Asian openbill stork	*Anastomusoscitans*	L.C.	IV	R	Marshy area opposite temple
Family Phalacrocoracidae						
9	Indian cormorant	*Phalacrocorax fuscicollis*	L.C.	IV	R	Water bodies across the campus
Family Scolopacidae						
10	Common sandpiper	*Actitishypoleucos*	L.C.	IV	M	Opposite Director's residence
Order Columbiformes						
Family Columbidae						
11	Eurasian collared dove	*Streptopeliadecaocto*	L.C.	IV	R	Across the campus
12	Spotted dove	*Streptopelia chinensis*	L.C.	IV	R	Trees near all family quarters, Botanical garden
13	Yellow footed green pigeon	*Treronphoenicoptera*	L.C.	IV	R	Near campus gate, opposite Community hall, Botanical garden
Order Coraciiformes						
14	Common kingfisher	*Alcedoatthis*	L.C.	IV	R	Temple pond
15	Stork billed kingfisher	*Pelargopsis capensis*	L.C.	IV	R	Opposite temple, *Melia composita* plantation
16	White-throated kingfisher	*Halcyon smyrnensis*	L.C.	IV	R	Wetlands across the campus
17	Indian roller	*Coracias benghalensis*	L.C.	IV	R	Near Community hall

18	Blue-tailed bee-eater	*Meropsphilippinus*	L.C.	IV	M	On electric supply cables near museum building
19	Green bee eater	*Meropsorientalis*	L.C.	IV	R	Opposite Director's residence
Order Cuculiformes						
Family Cuculidae						
20	Asian koel	*Eudynamysscolopaceus*	L.C.	IV	R	All across the campus
21	Common hawk cuckoo	*Heirococcyxvarius*	L.C.	IV	R	Behind Type-I quarters
22	Greater coucal	*Centropus sinensis*	L.C.	IV	R	Across the campus
23	Lesser coucal	*Centropusbenghalensis*	L.C.	IV	R	Citronella site
Order Gruiformes						
Family Rallidae						
24	White-breasted waterhen	*Amaurornisphoenicurus*	L.C.	IV	R	Wetlands,swamps across the campus
Order Passeriformes						
Family Campephagidae						
25	Scarlet minivet	*Pericrocotusspeciosus*	L.C.	IV	R	Opposite temple
Family Corvidae						
26	Grey treepie	*Dendrocittaformosae*	L.C.	IV	R	Botanical garden, Behind Bambusetum
27	House crow	*Corvus splendens*	L.C.	V	R	Behind Type-II & III quarters
28	Large-billed crow	*Corvus macrorhynchos*	L.C.	IV	R	Behind Type-II & III quarters
29	Rufous treepie	*Dendrocittavagabunda*	L.C.	IV	R	Across the campus
Family Cisticolidae						
30	Common tailorbird	*Orthotomussutorius*	L.C.	IV	R	Near Type-III quarters and Power house
Family Dicruridae						
31	Black drongo	*Dicrurusmacrocercus*	L.C.	IV	R	Across the campus
32	Greater racket-tailed drongo	*Dicrirusparadiseus*	L.C.	IV	R	Forest patch behind temple pond, Botanical garden
33	Hair-crested drongo	*Dicrurushottentotus*	L.C.	IV	R	Botanical garden, Forest behind Type -I,II quarters

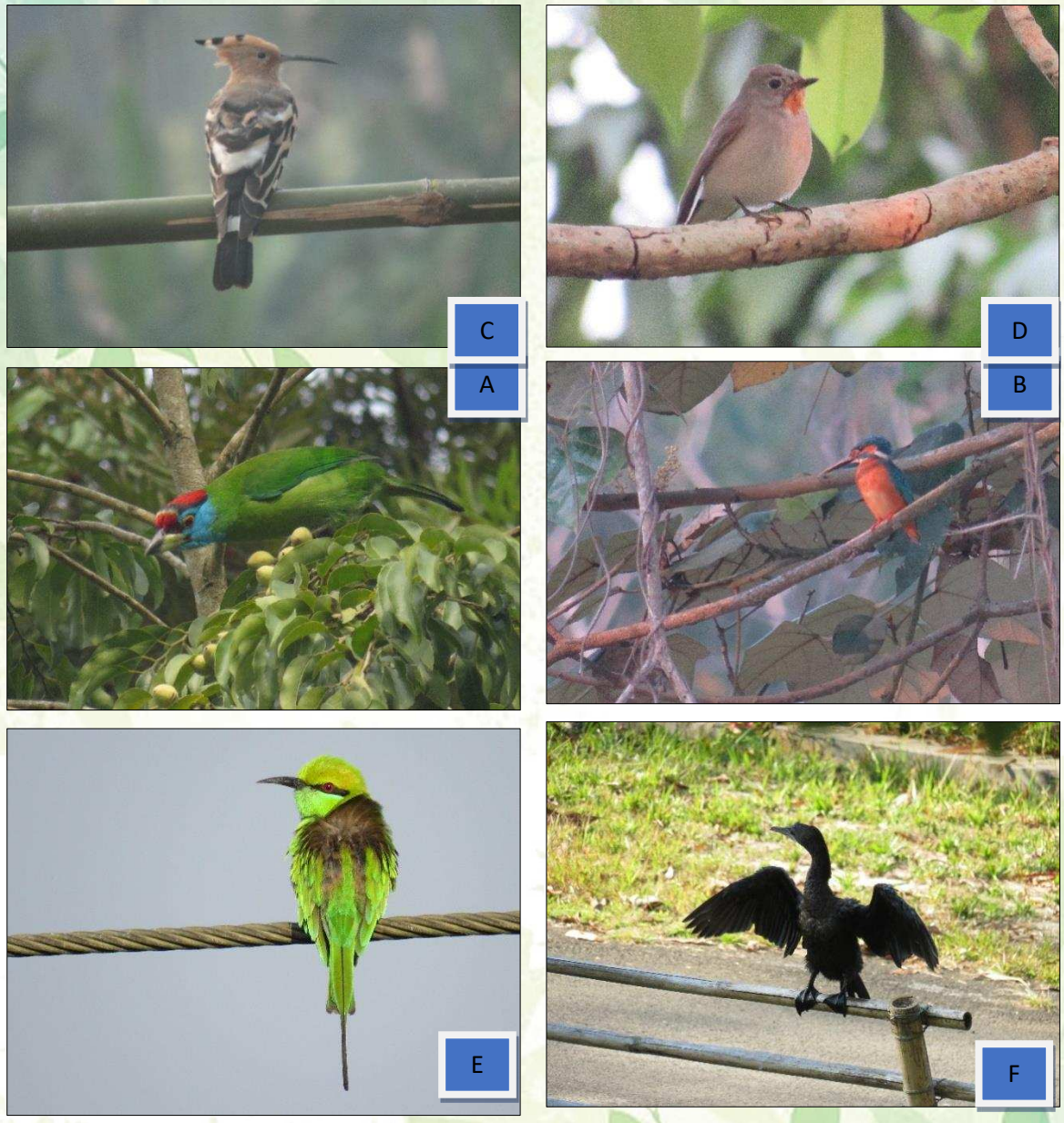
Family Estrildidae						
34	Scaly breasted munia	*Lonchurapunctulata*	L.C.	IV	R	Near Type-II quarters, Power house and new bamboo plantations
Family Hirundinidae						
35	Barn swallow	*Cecropisstriolata*	L.C.	IV	R	Near power house
Family Laniidae						
36	Grey backed shrike	*Laniustephronotus*	L.C.	IV	M	On electric cables across the campus
37	Large woodshrike	*Tephrodornisvirgatus*	L.C.	IV	R	
Family Locustellidae						
38	Striated grassbird	*Megalurus palustris*	L.C.	IV	R	Near Type-II quarter
Family Muscicapidae						
39	Blue whistling thrush	*Myophonus caeruleus*	L.C.	IV	R	Near Type-II quarters
40	Oriental magpie robin	*Copsychussaularis*	L.C.	IV	R	Across the campus
41	Taiga flycatcher	*Ficedula parva*	L.C.	IV	M	
Family Nectariniidae						
42	Crimson sunbird	*Aethopygasiparaja*	L.C.	IV	R	Near Type-V quarters, temple and Poplar plantation
43	Purple sunbird	*Cinnyris asiaticus*	L.C.	IV	R	Botanical garden
Family Oriolidae						
44	Black-hooded oriole	*Oriolusxanthornus*	L.C.	IV	R	Near campus gate and on trees with dense canopy
Family Paridae						
45	Great tit	*Parus major*	L.C.	IV	R	Near Scientist's hostel
Family Passeridae						
46	Eurasian tree sparrow	*Passer montanus*	L.C.	IV	R	Parking shed near Scientist's hostel
47	House sparrow	*Passer domesticus*	L.C.	IV	R	Parking shed near Scientist's hostel
Family Pycnonotidae						
48	Red-vented bulbul	*Pycnonotuscafer*	L.C.	IV	R	Across the campus

49	Red-whiskered bulbul	*Pycnonotusjocosus*	L.C.	IV	R	Near temple, *Melia composita* plantation
Family Rhipiduridae						
50	White throated fantail	*Rhipiduraalbicollis*	L.C.	IV	R	Opposite temple
Family Stenostiridae						
51	Grey headed canary flycatcher	*Culicicapaceylonensis*	L.C.	IV	R	Forest patch behind temple pond
Family Sturnidae						
52	Chestnut tailed starling	*Sturniamalabarica*	L.C.	IV	R	Electricity poles and trees around the campus
53	Common myna	*Acridotheres tristis*	L.C.	IV	R	Across the campus
54	Hill myna	*Gracula religiosa*	L.C.	I	R	Trees outside auditorium, near field labs
55	Jungle myna	*Acridotheresfuscus*	L.C.	IV	R	Behind Type-I quarters, Botanical garden
Family Zosteropidae						
56	Oriental white eye	*Zosteropspalpebrosus*	L.C.	IV	R	Near temple and opposite Director's residence
Order Piciformes						
Family Picidae						
57	Black rumpedflameback	*Dinopiumbenghalense*	L.C.	IV	R	*Melia composita* plantation, South of Genetics Division
Order Psittaciformes						
Family Aegithinidae						
58	Common iora	*Aegithina tiphia*	L.C.	IV	R	Near GTI building and Temple
Family Megalaimidae						
59	Blue throated barbet	*Psilopogon asiaticus*	L.C.	IV	R	On trees with dense canopy
60	Lineated barbet	*Psilopogonlineatus*	L.C.	IV	R	Forest behind Type-II quarters, Botanical garden
Family Motacillidae						
61	White wagtail	*Motacilla alba*	L.C.	IV	M	Near Scientist's hostel
Family Psittacidae						

62	Alexandrine parakeet	*Psittacula eupatria*	N.T.	IV	R	Near temple pond
63	Rose ringed parakeet	*Psittacula eupatria*	L.C.	IV	R	Near temple, Forest behind Type-II quarters
Sturnidae						
64	Asian pied starling	*Gracupica contra*	L.C.	IV	R	Across the campus
Order Strigiformes						
Family Strigidae						
65	Asian barred owlet	*Glaucidium cuculoides*	L.C.	IV	R	Community hall, Near Auditorium

Table 1. Checklist of avifauna recorded from RFRI Jorhat Campus, Assam during (2018-2020) L.C.- Least Concern; N.T.- Near Threatened; R- Resident; M-Migratory

Of the 65 species recorded from the study area, all except Alexandrine parakeet (*Psittacula eupatria*) were of Least concern according to the IUCN Red list. Alexandrine parakeet is a Near threatened species (**8**). 63 species were listed in Schedule-IV of the Wildlife Protection Act-1972, while Hill myna has been listed in Schedule-I and House crow in Schedule-V under the Indian Wildlife act (**9**). 5 of the recorded species are migratory, Common sandpiper (*Actitishypoleucos*), Blue-tailed bee eater (*Meropsphillipinus*), Grey backed shrike (*Laniustephronotus*), Red breasted flycatcher (*Ficedula parva*) and White wagtail (*Motacilla alba*), while the rest 60 species are reported to be resident (**1**,**7**).



Photographs of some birds observed at RFRI Jorhat Campus.
[A- Common hoopoe *Upupa epops*; B- Taiga flycatcher *Ficedula parva*; C- Blue throated barbet *Psilopogon asiaticus*; D- Common kingfisher *Alcedoatthis*;
E- Green bee-eater *Meropsorientalis*; F- Indian cormorant *Phalacrocorax fuscicollis*]

Discussion

The study conducted at Hollongapar Gibbon Wildlife Sanctuary during 2007-2009 (**4**) and at Jhanjhimukh- Kokilamukh IBA wetland assemblage during 2016-2018 (**5**) found a healthy avifaunal population. The institute campus falls within a few

kilometers of these areas, but the diversity within the campus is considerably less. This lack of avifaunal diversity could be due to the lack of any prominent wetland within the campus, lack of a large pure forest patch, dynamic land use/cover or due to being surrounded by tea gardens and agricultural fields. Even though the campus has a healthy tree cover, most of it is in the form of plantations (with proper spacing between the trees), making it inappropriate for the raptors to perch (since only 2 raptor species were observed- Asian barred owlet and Common hawk cuckoo). The lack of a prominent wetland might be the reason behind a smaller number ofwetland dependent birds. There is only a small patch of grass dominated area within and around the campus, and thus only a couple of grassland birds were recorded. Experimental trials for various plantations have been conducted within the campus, resulting in a current decline in tree cover, that eventually will change positively with the growth of these plantations. A preliminary study conducted in 2010 found only 34 species (the low diversity might be due to the short duration of that study). A considerable increase in avifaunal diversity (especially insectivores) during the current study might be due to parts of the campus being tilled to prepare the land for plantations. A similar study needs to be conducted when the tree cover has been restored, so as to get an insight on the way the various land use/covers affects the presence of avifauna.

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Tree fodder: An important component of agroforestry system of Assam

Priyanka Devi[1] and Rahul Saikia[2]

1. Ph.D Scholar, Department of Agronomy, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh

2. Ph.D Scholar, Department of Agronomy, College of Post Graduate Studies and Agricultural Sciences, Central Agricultural University (I), Umiam, Meghalaya

India is an agriculture centric nation. Livestock is an important component of Indian agriculture contributing nearly 4.11% towards gross domestic product (GDP) and almost 25.6% towards total agriculture GDP. It is the source of livelihood for two third of the rural community and supports employment to about 8.8% of the Indian population. Likewise, agriculture forms the backbone of economy of Assam. More than 52% of the total labour force are found to be engaged in agriculture and allied activities. Agriculture and allied sectors contribute 19.89% to state's GDP of which 5.30% is contributed by livestock and poultry. With a population of 109.09 lacs, cattle comprise 60% of total livestock of the state. According to the 20thlivestock census conducted in 2019, it was reported that there has been a decline in livestock population by 5% from 2012. This might be due to the negligence on the part of the farmers with respect to appropriate feed, health and care and rearing practices. Also, crop husbandry remains a predominant agricultural activity among the farming community that draws much attention. Livestock rearing in Assam is particularly dealing with indigenous cattle, buffalo, goats, pigs and poultry. Animals are fed with crop residues, food waste and weeds plants that drastically reduces their health and quality. Thus, it becomes imperative to emphasize on livestock sector as it supports livelihood and national GDP.

Plant species belonging to the family *Poaceae* and *Leguminosae,* serves as the largest domain for providing both food and feed for humans and animals, respectively. Crops such as maize, oats, sorghum, lathyrus and even rice (particularly *Sali* rice variety Gitesh) are grown as dual-purpose crops. They provide nutritious green fodder that substantially improves quality of livestock and the products derived from them. However, these crops grow luxuriantly during the *kharif* season due to abundant rainfall but grows almost meagrely during the *rabi* season due to the lack of rainfall and irrigation facilities. Thus, there occurs scarcity of fodder during the *rabi* season that is generally known as lean period. Oats, ryegrass, berseem, lathyrus, etc. are some important *rabi* season fodder crops but their cultivation is neglected since their sowing window and harvesting of *Sali* rice coincides. Thus, adoption of preservation techniques like silage and/ or hay prepared out of the surplus green fodder obtained during the rainy season can act as a buffer. However, this technique involves scientific know how and lengthy procedures that hinders its adoption among small and

marginal farmers. Moreover, these fodder species lack some important minerals like calcium that are utmost important for obtaining quality animal produces. Under such a scenario, agroforestry is a potential source of nutrient rich for age essentially during the lean period besides maintaining ecological sustainability.
Agroforestry is a collective name for land-use systems and technologies where woody perennials (trees, shrubs, palms, bamboos, etc.) are deliberately used on the same land-management units as agricultural crops and/or animals, in some form of spatial arrangement or temporal sequence (FAO). It is a dynamic, natural resource management system that offers ecological and economical interactions between the different components and provides increased social, economic and environmental benefits for land users at all levels. The three important types of agroforestry systems are Agrisilvicultural systems (that incorporates crops and trees together such as alley cropping or homegardens), Silvopastoral systems (combines forestry andgrazing of domesticated animals on pastures, rangelands or on-farm) and Agrosylvopastoral (that includes trees, animals and crops). Tree species like, *Artocarpas heterophylus* (Kothal), *Mangifera indica* (Aam), *Leucaena leucocephala* (Subabul), *Ficus benghalensis* (Borgos), *Ficus religiosa* (Ahotgos), *Gmelina arborea* (Gomari), *Albizzia lebbeck* (Kothiakoroi), *Moringa oleifera* (Sojina), *Terminalia catappa* (Kath badam) etc. and other forest grass species like *Bambusa* sp, *Dendrocalamus* sp can be successfully used as silvicultural component in agroforestry-based cropping system in Assam that can serve as forage reservoir. Fodder grass species that can be incorporated in agroforestry systems are mentioned below:

Sl.No	Crop	Variety	Green fodder yield (q/ha)
A.	**Perennial**		
1.	Hybrid napier	CO – 2, CO – 3, CO – 4	90- - 1200 (4 – 5 cuts)
2.	Guinea grass	Hamil, PGG – 3, PGG – 9	800 – 900 (5 – 6 cuts)
3.	Setaria	Kazungula, Nandi, Narak,PSS-1	900 – 1000 (4- 5 cuts)
4.	Para grass		900 – 1000 (4- 5 cuts)
B.	**Annual: *Kharif***		
1.	Maize	Ganga -5, African tall	300 – 350
2.	Dinanath	Bundaldinanath, JP-12, PS-3, Pusa-19	500 – 600 (2 – 3 cuts)
3.	Teosinte	Sirsa, TL-16	300 – 350
C.	**Annual: *Rabi***		
1.	Oats	Kent, JHO-822, RO-19	300 – 350
2.	Ryegrass	Makhan grass	350 – 400

D.	Legume		
1.	Cowpea	UPC-4200, EC 4216	250-300
2.	Lathyrus	Shyamalima, K-1, K-16	200-250
3.	Ricebean	Nirmal, Madhuri	120-250

(*Source*: Sharma and Neog, 2015)

The basic advantage of tree fodder species is that they demand less attention and fewer management practices, suitable for cultivation in degraded land and helps in recycling nutrients thereby benefiting crops grown along with them. Agroforestry is scientifically well managed land use system for effective utilization of solar radiation that provides food, feed and fuel and also serves as windbreaks and shelterbelts. It has been established as a tool for bringing degraded and waste land under cultivation and reclaim polluted land. It has the capacity to sequester carbon and thus helps in achieving the dual approach of maintaining adequate soil organic carbon and mitigation greenhouse gas emissions. Agroforestry is also a source of economy for the farmers and is thus gives added benefits of deriving income when crops fail due to aberrant weather conditions. However, some trees and grass species contain alkaloids, tannins and other anti-nutritional components which in their higher concentration will affect animal health. This provides scope for conducting research to develop techniques for reducing their toxic levels. Also, the allelopathic effect prior to designing agroforestry system must be addressed for getting optimum yields.

Assam is considered as the biodiversity hotspot with numerous plant species that can be used as good source of nutritive forages. Lowland rice cultivation accounts for roughly two thirds of total agricultural land. In upland areas, there is significant potential for implementing region-specific agroforestry models to sustain production and provide social, economic, and environmental benefits. Scientific and site-specific agroforestry models can be an impressive tool to tackle the modern day problem of food, feed and nutritional security and climate change.

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Value addition in Medicinal Plants

Munni Das
Project Assistant
ICFRE-Rain Forest Research Institute, Jorhat

Plants and their derivatives are used for healthcare purposes in various systems of folk remedy since ancient times and about 80% of the world's population rely upon herbal medicine to treat different ailments. The use of traditional medicine has increased over the past two decades which create new income generating opportunities especially for rural populations as well as many necessitous households who collect medicinal plants from wild and sell. Value addition in medicinal plants ensures that the plant materials meet appropriate identification and quality standards. In present scenario, medicinal plants are finding diverse uses in our society from medicine to cosmetics, herbal drinks, herbal foods and other articles in the daily use. In order to meet the increase in global demand various medicinal plants are needed to be cultivated to ensure their uniform supply for processing of value-added products. Finished products enriched with vitamins and minerals available in medicinal plants may find wider acceptability in the global market that will help to boost the earning generated through export of agricultural products.

Value addition of medicinal plants is essential for economic development and therapeutic usefulness of raw pharmaceuticals. Adding value to a product also aid in the profitability as well as empowers entrepreneurial opportunities of the society. It helps to provide safety, stability and standardized quality of food to the consumers, reduction in post-harvest losses, low import and high exports and encourage the growth of subsidiary industries that leads to financial stability of the farmers. Low and high level of value addition through processing can be achieved by involvement of unemployed, educated youth and unskilled rural youths. This will ensure a variety of value-added finished goods which can be further used for national and international trade.

Plan of action for value addition in medicinal plants:

Apart from value addition in medicinal plants, there should be some improvement in the existing system of collection or cultivation of medicinal plants to reap the maximum potential of the sector. Improvements are needed in the areas of post-harvest handling, processing and product presentation. To achieve the value addition of the medicinal plants and lessen the contamination and wastage, the following direct, indirect or semi-processing techniques shall be followed.

A. Direct value addition:
i. Collection in proper seasons: To obtain the right composition and concentration of secondary metabolites which are of medicinal importance, the harvesting should be performed at right stages and seasons.
ii. Grading and sorting: These two steps will be a means of value addition and market potential in order to get higher value for the produce and quality specification.
iii. Cleaning/washing: Removal of any foreign inorganic matter and contaminants.
iv. Drying: As per requirement, the drying process has to be performed to maintain the desired quality avoiding deterioration.
v. Packaging: Most important step that keeps contents safe from contaminants or loss of the material under the specified conditions of handling, shipment or storage.
B. Indirect value addition: Includes quality testing for purity and strength. Testing for the physico-chemical standards i.e., moisture, foreign organic matter, ash content, extractives, pesticide residues, etc.
C. Semi-processing of the medicinal plants to value added products: Semi processed products include powder, capsules and extracts of herbal plant materials that does not involve expensive techniques for processing.

Areas for development:

The technology for the processing of medicinal crops is easy and almost all the required machineries and manufacturing provisions are available in maximum parts of our country. Also, the extraction processes of medicinal plants can be carried out locally, so cultivation for commercial purpose would be possible in many areas of the country even with minimum participation of farmers. Therefore, it is essential to ensure the availability of cultivable land, larger consistent supply and better post-harvest handling. Country authorities must ensure the development of effectual strategies in order to support improved cultivation, provide standard quality planting materials and investment in modern technologies.

Conclusion:

Destructive harvesting and development in industrial sector can lead to continuous depletion of habitat in the future which will remain as a threat to many medicinal species in the developing countries. The practices of wild cultivation must be started to prevent the depletion. Sustainable improvement of industries based on plants required multi-layered activities and alliance between Joint Forest Management Committees, scientists, country authorities, NGO's and most importantly the local farmers. Thus, it becomes mandatory to develop more action-oriented objectives so that the exploitation up to full potential of these

resources as well as conservation can be done with a boost to the development of national economic status and rural household incomes.

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Unlocking the Healing Secrets of Assam's Wild Medicinal Plants

Amrita Tirkey[1] & Darika Nath[2]

1. Junior Project Fellow, ICFRE- Rain Forest Research Institute, Jorhat

2. Research Scholar, ICFRE- Rain Forest Research Institute, Jorhat

Nestled in the lush landscapes of northeastern India, Assam is a treasure trove of biodiversity, harboring a rich array of flora and fauna. Among its verdant forests and rolling hills lie hidden gems - medicinal plants deeply ingrained in the traditional knowledge and cultural heritage of the region's indigenous communities. The rich herbal legacy is inherited by Northeast India. It is home to an abundance of natural resources, such as medicinal herbs and other plants, and is one of India's most botanically rich areas. Most of the medicinal plants used by local people and tribes of the state of Assam are indigenous and are not known to the vast world of phyto-chemical science and research.

Cultural heritage: The utilization of wild medicinal plants in Assam is not merely a matter of practical healthcare but a deeply ingrained aspect of its cultural heritage. Across generations, the indigenous peoples of Assam have upheld this traditional knowledge, which serves as the cornerstone of healthcare practices in rural communities. Particularly in the remote and hilly regions, tribal communities rely extensively on herbal remedies to address a wide array of common ailments such as colds, coughs, asthma, headaches, fevers, pneumonia, skin diseases, and stomach aches. This reliance underscores the significance of these natural resources in sustaining the health and well-being of the local population. Moreover, the ethno-medicinal wisdom passed down among various ethnic groups in Assam holds immense promise for the development of novel and more effective drugs to combat infectious diseases. By tapping into this reservoir of traditional knowledge and leveraging the rich biodiversity of the region, Assam can potentially contribute substantially to the advancement of medical science, offering hope for improved healthcare solutions rooted in age-old practices and local resources. Some of the names of common wild medicinal plants and their uses are mentioned below:-

1. Leucas aspera-

Local name- Durun bon, Family- Lamiaceae

Uses- The leaves are crushed on the hand and juice is applied. 2-3 drops of juice is applied on the nose and inhaled. In traditional medicine, the entire plant is used

as an insecticide and is recommended for the treatment of coughs, colds, painful swelling, and persistent skin eruptions.

2. Colocasia esculenta-

Local name- Taro, Family- Araceae

Uses- Taro is a good source of vitamins and minerals. These nutrients play essential roles in maintaining overall health and well-being, supporting various bodily functions such as nerve function, muscle contraction, and immune system regulation. The corm of taro is used as a remedy for body aches. Individuals with specific medical conditions or allergies should consult healthcare professionals before incorporating taro into their diet or using it for medicinal purposes.

3. Mikania micrantha-

Local name- Prem lata/ Mile-a-Minute, Family- Asteraceae

Uses- Mikania micrantha is a fast-growing invasive vine. The ointments prepared from Mikania micrantha are applied to wounds and sores to facilitate healing. The plant's leaves or extracts are applied externally to the affected area to reduce rashes and relieve itching. Its cooling and anti-inflammatory effects may provide relief from various skin irritations. Mainly the plants are used in blood coagulation.

4. Lasia spinosa-

Local name- Sengmora/Kohila, Family- Araceae

Uses- Lasia spinosa has been traditionally used to treat various ailments, including respiratory disorders, gastrointestinal problems, skin conditions, and reproductive health issues. Decoction is made from the rhizomes of the plants with an addition of little amount of salt, which is used for the ailments of kidney stones and gall bladder stones. The leaf extract is consumed by the Bodo Tribe as a source of multivitamins. Traditional healers often rely on empirical knowledge passed down through generations to harness the therapeutic potential of Lasia spinosa.

5. Drymaria cordata

Local name- Laija bori, Family- Caryophyllaceae

Uses- It is a wild plant also known as 'Tropical Chickweed' is traditionally used to cure blood dysentery. The whole plant is decocted and consumed in a paste form. It has an effective property to cure stomach ulcers. In India, the plant's whole leaves are used for their anti-diabetic, analgesic, diuretic, and anti-inflammatory qualities. Leaf paste is also used to treat skin conditions including scabies and eczema, also the paste are used in wound healing.

6. Oroxylum indicum

Local name- Tarlu, Family- Bignoniaceae

Uses- The plant's digestive properties are utilized in treating gastrointestinal disorders, including diarrhea, dysentery, and indigestion. The paste of root and bark decoction is consumed by the Naga tribe for treating dysentery, jaundice and rheumatism. Similarly, different tribes such as Rabha, Garo, Jaintia used different parts of the plant for various ailments. The Halam people of northeastern India often administer a glass of bark decoction mixed with two spoons of sugar to treat jaundice.

7. Costus speciosus

Local name- Jomlakhuti, Family- Costaceae

Uses- Rhizomes of the plants are mainly used to cure diabetes, inflammation and headache. It has many ethno-medicinal uses, such as the leaves are used in curing several skin diseases. Juice is prepared from the flower of the plant and consumed to cure leucorrhoea problem in women.

8. Clerodendrum viscosum Vent.

Local name- Bhetei tita, Family- Verbanaceae

Uses- Leaf decoction is used for the ailment of malaria. Roots decoction is used for treatment of bronchitis and pneumonia. Its anti-inflammatory properties are used for curing inflammatory and stomach ulcers.

9. Polygonum hydropiper

Local name- Bihlongoni, Family- Polygonaceae

Uses- Leaf extract is used to cure headache, fever, pneumonia. The leaves are crushed with 10-12 pepper and used for treating headaches. The Santhals and Kumarikata Tribe of Assam used the plants for pain relief.

10. Phlogacanthus thyrsiformis

Local name- Tita-phul, Family- Acanthaceae

Uses- It is used to cure cough, colds and asthma. The flowers are used as antidote towards soreness of skin, pox etc. The Karbi Tribe of Assam consume the flower and fruit of the plant for curing fever. It is also used for jaundice.

Conclusion: - The vast array of wild medicinal uses showcased in this article highlights the profound wisdom and resourcefulness of indigenous cultures worldwide. The traditional knowledge passed down through generations underscores the importance of preserving biodiversity and respecting indigenous practices. However, the utilization of wild medicinal plants faces challenges due to rapid urbanization, habitat destruction, and the erosion of traditional knowledge. As younger generations migrate to urban areas, there is a risk of losing this valuable cultural heritage. Unlike the listed 10 species, there are a vast number of wild medicinal plants which are yet to be recognized and have to undergo many phytochemical test for further use in diverse sectors. Collaborative efforts between local communities, NGOs, and governmental organizations aim to promote sustainable harvesting practices and preserve traditional healing knowledge. Conservation of the wild medicinal plants is very necessary as it can address the global challenges and can establish a remarkable connection with nature and are profound for its healing power. Commercialization of wild medicinal plants presents economic opportunities for local communities. Supporting the utilization of wild medicinal plants empowers indigenous communities to maintain control over their resilience in the field of environmental and socio-economic challenges.

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Monoculture and its role on Biodiversity

Monali Saikia
Jorhat, Assam

Introduction

Planting and cultivated a single species of plants or crop varieties in a large area is called monoculture. In developing countries where agriculture is the main economic source, monoculture is practiced widely. Monoculture, or the system of having only one crop at a time growing on a farm plot, is a world-wide phenomenon. It has become synonymous with acceptable, modern farming practice, with all technological inputs (pesticides, chemical fertilizers, harvesting machines, etc.) developed for and geared to its service. Everywhere it is officially, academically, but uncritically regarded as the only rational way to conduct agriculture. (Igbozurike, U.M., Nsukka, 1978). To meet the growing demand of ever increasing human population, cultivating high yielding crops in large quantity and introducing foreign species was taken as a necessary measurement in developing countries. Monoculture is a term that can be utilized in many contexts. It can be used to describe any instance where a single practice, species, or behaviour is favoured by a population and exploited to the point where other practices, species, or behaviours are at the risk of extinction (Suzuki D, Nov 1999;Norberg-Hodge H.,1998; Zhu Y, Wang Y, Chen H, Lu B-R.,2003).during 1960, some international organization such as WFO, world bank released information about global food crisis and therefore several large scale program were implemented to increase food supply. The 1960s and the years that followed came to be labelled as the Green Revolution (Panthong K et.al; Freedman B.; Wilson C.). An innovation that was introduced during this period was the High Yield Variety Seeds (HYV), which was designed to increase crop yields. These seeds required high inputs of fertilizer and water, monoculture cultivation, and modern machinery to provide their maximum potential (Bowring F.). Monoculture became more prevalent since 1945s and replaced crop rotation as it is economically expensive to grow multiple crops in large scale and the cost of special equipment required for multiple crops is very high. Crops produced on monoculture plantations are often subsidised by the government. The subsidisation takes the form of insurance, guaranteeing a minimum selling price despite any decline in market value. Growing same crops for years reduces the cost of fertilizer, implementation of new equipment (sources studysmarter.uk).

Disadvantages of Monoculture

Continuous practice of monoculture decade after decade adversely affected the diversity of ecosystem and also its impact on human health. Because of low genetic diversity, monoculture planation become highly susceptible to pathogen borne diseases and cannot develop resistance to pest and pathogen borne

diseases. Because of that monoculture agriculture heavily relied on insecticides and pesticides. Increasing amount of chemicals for longer period leads to several problems- environment pollution, health problem and reduction of biodiversity.
Growers that practice crop monoculture generally do so for economic reasons. The selected crop is the most profitable and any profitability loss from yield declines are less than that which occurs from any rotational options available. In these situations, the ability to minimize the losses associated with monoculture can provide the best option to increase productivity and profitability (R.J. Cook and D.M. Weller). But repetition of same crops leads to yield declining, pest susceptibility, loss of genetic variation, loss of soil fertility and so on. Monoculture represents a decline of species over a particular area. as a deliberate choice of agriculture in food raising , monoculture become a by - product of unintentional human activity that threatens diversity of ecosystem(John d potter).

Impacts on Biodiversity

Recently, a study cited by the Global Crop Diversity Trust suggested that up to 95% of some fruit and vegetable varieties in the United States have become extinct over the past 100 years (Global crop diversity trust,2014). The trend in our society is to move away from biodiversity and toward monoculture, which is the focus on growth of single crops, typically in huge farms run by large Multinational Corporation.

Among all the plant species available on earth, approximately only 45% plants are potentially edible. However, only ~ 50,000 plant species are actually used as foods or in foods as spices, and, of these, only 15 crop plants are cultivated to provide 90% of the world's food energy intake. These include rice, wheat, and corn, the major food crops that most humans commonly eat (FAO, 1995). A tiny fraction of edible plant with unique flavour and properties are widely used for consumption neglecting the rest (R. Rountree, 2015).

Genetically modified crops are produced in large scale to deal with poverty and increasing hunger crisis. A single gene is replaced with a gene that confers resistance to a number of herbicides. On the narrow focus of genetically altered herbicide-resistant crops results in a lack of discussion about long-term sustainable approaches, such as integrated weed management (Mortensen DA, Egan JF), to development of GMO plants that are tolerant of additional herbicides, such as 2,4-D (2,4-dichlorophenoxyacetic acid), a component of Agent Orange, which has long been implicated in a wide range of health problems (R. Rountree, 2015).

The Center for Health and the Global Environment at the Harvard School of Public Health report (Chivian E. Bernstein A., Dec 5, 2014) stated that GMO foods may actually damage biodiversity by promoting greater use of pesticides associated with GMO crops. These pesticides are toxic to some species and will introduce

exotic genes and organisms into the environment, which will become woven into the DNA of wild and traditionally cultivated plants. A recent study suggests that, if farmers simply diversified their crop rotations—such as including a small grain crop, for example, oats, along with the corn/soy rotation and offseason cover crops—weeds were suppressed even while using less fertilizer and herbicides (Davis AS, Hill JD, Chase CA, et al., 2012). Pesticide, herbicide, fumigant are used regularly in defence of monoculture which kills the natural microbial biota present in soil. Once destroyed, it can never be replaced (R. Rountree, 2015).

Higher diversity plant communities may have a higher likelihood of including more drought resistant species that can compensate for drought-sensitive species ("insurance effects"). Alternatively, higher diversity communities may alter environmental conditions and improve performance of even drought sensitive species. Legumes grow in monoculture supressed in dry season, the same species remain unaffected by drought when growing in higher diversity mixtures. (A. J. Wright, L. Mommer, K. Barry, and J. van Ruijven).

A recent Meta-analysis showed that with increased diversity in intraspecific cultivar mixtures disease presence is reduced and crop yields increased (Reiss ER, Drinkwater LE, 2018). Crop plants are under artificial selection for high yield, and may therefore exhibit less genetic polymorphism than those in the wild (Alice K.E. Ekroth et al).

Conclusion

Although monoculture leads to adequate food supply to human population and high yielding product at relatively low cost, long term practices increase the chances of extinction of biodiversity. Reduced bird population, increased specific host parasite population, reduced genetic variability inedible crops, extensive use of pesticides; reduced drought resistance and precipitation resistance in plants, etc. are side effects of monoculture. Pollution, soil erosion, shrinking of aquatic and terrestrial life etc., also are directly or indirectly related to monoculture planation. Shifting from monoculture to polyculture, crop rotation with multiple crops and practice of traditional crop culture using modern technology are few methods that may increase the complex diversity in environment and maintain a balance in ecosystem.

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From Fields to Fortune: Unlocking Opportunities with Bamboo

Temjensola Jamir
Ph.D. Scholar, ICFRE-Rain Forest Research Institute, Jorhat- Assam

Bamboo, often hailed as the "plant of a thousand uses," holds the promise of transforming fields into fortunes for farmers and entrepreneurs alike. With its remarkable versatility, sustainability, and economic potential, bamboo presents a wealth of opportunities for those willing to explore its countless applications.

The Green Gold of Bamboo: A fast-growing and renewable resource, offers a sustainable alternative to traditional crops. Its ability to thrive in diverse climates and soil conditions makes it a resilient and low-maintenance crop for farmers. In an era where sustainable agriculture is paramount, bamboo emerges as a versatile, rapidly growing plant that holds the key to transforming rural landscapes, empowering farmers to not only enhance soil health and biodiversity but also generate a steady source of income while contributing to climate change mitigation. The green gold of bamboo lies in its multiple uses, ranging from construction materials and furniture to handicrafts and textiles, offering a wide array of economic opportunities for farmers and entrepreneurs.

One of the key strategies for unlocking opportunities with bamboo is diversification and value addition. Farmers and entrepreneurs can tap into niche markets and cater to diverse consumer demands by exploring various products derived from bamboo. This diversification not only reduces dependency on a single crop but also enhances the resilience of farmers to economic fluctuations. Enhancing skills in bamboo cultivation, management, and value-added techniques can improve productivity, product quality, and market competitiveness. Training programs, workshops, and demonstrations on best practices in bamboo farming can greatly benefit farmers. Value-added products such as bamboo flooring, furniture, paper, and charcoal command higher prices in the market, providing a lucrative avenue for increasing profitability. Through innovation and creativity, bamboo can be transformed into high-quality, sustainable products that appeal to environmentally conscious consumers.

Bamboo's versatility, sustainability, and market demand create an ideal landscape for entrepreneurship, unlocking its full profitable potential. The growing demand for bamboo products in both domestic and international markets positions bamboo farmers at the forefront of economic opportunities. Bamboo's fast growth rate allows for frequent harvesting, offering quick returns on investment. Some species can be harvested in as little as three years, compared to hardwood species, which may take several decades. Entrepreneurs can explore opportunities across the bamboo value chain, from nurseries to eco-tourism ventures, fostering economic development and stimulating innovation. This fosters the growth of small and medium enterprises (SMEs), contributing to

economic development. Establishing bamboo-based enterprises not only generates employment but also stimulates innovation within the sector. Effective market development, facilitated through digital platforms, e-commerce, and strategic partnerships, enables entrepreneurs to connect with a broader consumer base, promote their products, and establish a robust brand presence. Bamboo cultivation extends beyond individual farmers, contributing to community development and social impact. By creating employment opportunities, particularly for marginalized groups, women, and youth, bamboo becomes a vehicle for social inclusion. It not only offers economic benefits but also contributes to environmental conservation, carbon sequestration, and climate resilience. The extensive root system prevents soil erosion by holding the soil together, especially on slopes and riverbanks, supports water retention, and fosters biodiversity conservation. Bamboo plantations also serve as carbon sinks, absorbing substantial amounts of carbon dioxide. With its fast growth, it can sequester up to 17 tonnes of CO_2 per hectare annually (Seethalakshmi et al., 2009), making a significant impact on climate change mitigation. By promoting sustainable practices such as organic farming, agroforestry, and fair trade, bamboo stakeholders can create a positive impact on the environment and society. Community engagement, capacity building, and knowledge sharing are essential for fostering a thriving bamboo ecosystem that benefits farmers, entrepreneurs, and local communities. Stakeholders who comprehend the importance of bamboo farming can leverage market linkages facilitated by organizations like Konkan Bamboo and Cane Development Centre (KONBAC). It can also advocate for supportive policies and initiatives at the local, state, and national levels. Effective policy frameworks can create an enabling environment for bamboo cultivation, ensuring the long-term sustainability and growth of the sector.

A case study on bamboo farming in the Sindhudurg and Latur districts of Maharashtra, India, conducted by the National Institute of Agricultural Extension Management (MANAGE), 2023, sheds light on the significance and potential of bamboo cultivation for rural development. Findings reveal that bamboo farming not only provides income opportunities for farmers but also supports environmental conservation and creates employment in related industries. It underscores the importance of sustainable bamboo farming practices in fostering economic prosperity and livelihood security in rural communities.

As we explore the journey from fields to fortune with bamboo, it becomes evident that this plant represents more than just an agricultural commodity; it symbolizes a pathway to sustainable livelihoods. By embracing bamboo cultivation, diversifying products, fostering entrepreneurship, and promoting sustainability, farmers and entrepreneurs can unlock a world of opportunities for prosperity and growth. From sustainable farming practices to innovative business ventures, bamboo offers a pathway to economic empowerment, environmental

stewardship, and community development. As we embark on this journey with bamboo, let us seize the opportunities it presents and pave the way for a greener, more prosperous future for all.

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Ecological and Economic Importance of Lichen

Manimoy Das
Junior Project Fellow, ICFRE- Rain Forest Research Institute, Jorhat

Introduction

Lichens are a symbiotic association between an alga (photobiont) or cyanobacteria (cyanobiont) and a fungus (mycobiont) where the photobiont or cyanobiont supply nutrient exchange i.e. carbohydrates, while mycobiont involves in chemical signalling and provides shape and structure. Based on growth form lichens are grouped into three categories (i.e. crustose, foliose and fruticose). It can be differentiate from fungi based on its photobiont content. Taxonomically lichens are defined based on his mycobiont content since it proportionally accounts for 95-98%, which plays a crucial role in the sexual reproduction. Theophrastus, called "Father of Botany" was first introduced the term "Lichen" in 370-285 BC. It is present in a wide range of habitats throughout the world and dominates terrestrial ecosystems. Its growing rate is less than 1cm/year. Lichens are easily identified for their colourful patches on tree barks, leaves, rocks and soils. Unpolluted air, good moisture, light, altitude, and undisturbed perennial substratum are favourable for the growth of lichens. They can absorb water, gases, and nutrients directly from the atmosphere. They can grow in diverse climatic conditions. Due to this ability of lichens, they are used as an indicator to identify anthropogenic disturbances such as atmospheric pollution, climate change, etc.

Ecological Importance:

Lichens are a very sensitive and measurable indicator for long term bio-monitoring. It is treated as indicator species of climate change because it can be affected more compared to other living organism in the ecosystem. The slow growth rate of lichens allows them to integrate the climate changes in micro level and modify their habitat according to their habitat requirements. It has served as valuable biomonitoring tools for many years due to their direct absorption of components from the air and their resilience against them. It is used as accumulation makers, large scale inventories for biomonitoring, air quality; investigate ecological quality, resistance against various pollutants, etc. In forest land variation of lichens population will help to investigate and understand the forest types and quality of the forests. Lichens also play an important role in nature in initiating soil formation. They secrete some kind of organic acids which gradually dissolve and disintegrate the rocks over which they grow. The rock particles with the dead organic remains of thalli form substrata fertile enough for other plants to grow subsequently.

Economic Importance:

Lichens are widely used as economic purposes in the world and India from several decades. The lichens also have been well known as valuable plant resources in the ancient time and are still used as medicine, food, fodder, perfume, spices and dyes. In India markets, lichens are famous by the name called 'Chharilia'. There are some different uses of lichens are discussed below:

- **Medicinal use:** Since ancient times lichens have been used in traditional medicine of the first Chinese and Egyptian civilizations. Their utilization in folklore as medicine has been cited in different pharmacopoeias of the world. In India, lichens also used as a household items mostly collected from Himalayan regions. Lichens are used for many different medicinal purposes like skin infections and sores, including sores in the mouth, eczema, respiratory and pulmonary diseases, strains, ulcers, bone fractures etc. Other external uses are stopping bleeding, dressing wounds, as a disinfectant, etc. Many of the traditional medicinal uses of lichens are probably related to their secondary metabolites, many of which are known to both be physiologically active and to act as antibiotics. The most commonly used genus of lichen is *Usnea*, which is used across the world for medicine. Example: *Usnea baileyi* (Stirt.) Zahlbr. Used as a medicine for respiratory health, etc.
- **Use as a Food and Fodder:** In some region of the world lichens are used as a traditional food and fodder. In Japan, one lichen genus name '*Umbilicaria*' are eaten as salad called 'Iwatake' which are rich in carbohydrates and fats. In North-eastern India lichens are used as a food of many local peoples. Example- '*Leptogium denticulatum*' a foliose lichen, is used by 'Adi' tribe of Arunachal Pradesh, in Sikkim, '*Everniastrum cirrhatum*' is eaten as a vegetables, etc. Lichens are also an important food for animals in coldest region of the world specially winter season due to the low vegetations. For example- during the winter reindeer eat common species of '*Usnea*' and '*Cetraria*', in south India, one species name '*Roccella montagnei*' used as a common fodder for animals, etc.
- **Industrial use:** Some lichens are also used in various industrial activities like as a tanning and dyeing product, cosmetics, perfumes, brewing, distillation, etc. Before the discovery of coal tar dyes, lichens had considerably used as dyestuffs. *Evernia purnastri, Evernia furfuracea*, etc. are some lichens which are commercially used as a production of aromatic resinoids which are extensively used in perfumes, flavours and cosmetics. In India, more than 35 species are used for preparation of perfumes which are called '*Hina attar*' in Uttar Pradesh. Some lichen species are also used in alcohol production. For example, In Sweden and Russia '*Cetraria islandica*' are widely used for alcohol production. This lichen is also used in confectionary. Some lichens are also used for production of natural products like salazinic acid produce

from '*Ramalina siliquosa*', lecanoric acid produce from '*Parmelia subrudectai*', etc.

Conclusion:

It is quite interesting to note that lichen is a very nutrient-dense and functional food also a very good environmental indicator which can help in various current climatic researches. Also its nutritional resource is very affected to mitigate health issues like malnutrition, etc. But due to lack of information people do not use lichens properly for good purposes. So, more exploration should needed about lichens, prepared their conservation strategies, cultivation methods for commercial uses, and share some valuable information to the public which will help in ecological stability and economic growth.

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मणिपुर और मेघालय में पाइन की मर्त्यता

काजल गुप्ता, गुरप्रीत कौर भमरा,
सुमोना चेटिया एवं राजीव कुमार बोरा
भा.वा.अ.शि.प. - वर्षा वन अनुसंधान संस्थान, जोरहाट, असम

परिचय

पीनस केसिया (*Pinus kesiya*) दक्षिण-पूर्व एशिया में व्यापक रूप से वितरित है। यह भारत, म्यांमार, तिब्बत, लाओस, वियतनाम, थाईलैंड, दक्षिण-पश्चिमी चीन और उत्तरी फिलीपींस में होता है। यह हिमालय में प्राकृतिक रूप से पाए जाने वाले छह पाइन में से एक है। भारत में यह मेघालय, अरुणाचल प्रदेश, नागालैंड और मणिपुर की खासी और जयंतीया पहाड़ियों में होता है। यह एक कम मांग वाली अग्रणी प्रजाति है जो आग से नष्ट हुए या स्थानांतरित खेती से खराब हुए क्षेत्रों में निवास करती है। इसे पूरे उष्णकटिबंधीय क्षेत्र में 800 से 1200 मीटर की ऊंचाई पर अच्छी जल निकासी वाली जगहों पर उगाया जाता है। इस देवदार की लकड़ी का उपयोग निर्माण, बक्से, फर्श, छत, पैनलिंग, जॉइनरी, फर्नीचर, खंभे और खदान के लिए किया जाता है। यह जहाज और नाव निर्माण, कृषि उपकरण, टर्नरी, लिबास, प्लाईवुड और रेलवे स्लीपर के लिए भी उपयुक्त है। इसका उपयोग उच्च गुणवत्ता वाले पार्टिकल बोर्ड के निर्माण के लिए किया जाता है, और पल्पवुड के रूप में इसका उपयोग बढ़ रहा है। लकड़ी का उपयोग ईंधन के रूप में, कोयला बनाने और मशालों के लिए किया जाता है। पीनस केसिया का ओलियोरेसिन अन्य पाइनस प्रजातियों की तुलना में समृद्ध है। इसमें 21 प्रतिशत तारपीन और 79 प्रतिशत राल होता है।

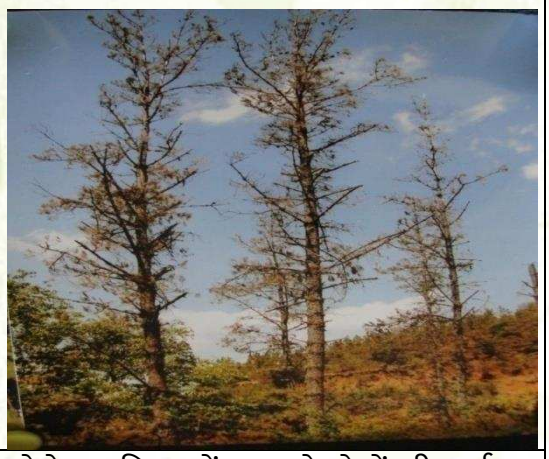
मणिपुर का अभिलिखित वन क्षेत्र 17,418 किमी^{2} है। चैंपियन और सेठ की वर्गीकरण प्रणाली (1968) के अनुसार राज्य में 8 अलग-अलग प्रकार के वन हैं, जो 5 प्रकार के समूहों से संबंधित हैं, अर्थात् उष्णकटिबंधीय अर्ध सदाबहार, उष्णकटिबंधीय नम पर्णपाती, उपोष्णकटिबंधीय चौड़ी पत्ती वाली पहाड़ी, उपोष्णकटिबंधीय देवदार और मोंटाने आर्द्र शीतोष्ण वन। उपोष्णकटिबंधीय देवदार के जंगल (राज्य के कुल वन क्षेत्र का 8.69 प्रतिशत) में, पीनस केसिया प्रमुख प्रजाति है, जो अक्सर अपने सहयोगियों के साथ शुद्ध रूप से विकसित होती है। यह वन प्रकार उखरूल जिले के उत्तरी और उत्तर-पूर्वी भाग, चंदेल के दक्षिणी भाग और मणिपुर के चुराचंदपुर जिले में पाया जाता है। मुख्य प्रजातियाँ हैं पीनस केसिया, क्वेरकस ग्रिफ़िथी, क्यू. सेराटा, कास्टानोप्सिसपीपी., बेतूला अलनोइड्स, एसर ओब्लांगम, सैलिक्स टेट्रास्पर्मा, रुसेमियालाटा आदि हैं।बताया गया है कि मणिपुर में पाइन की उत्पादक क्षमता कीटों और बीमारियों सहित विभिन्न जैविक कारकों से प्रभावित होती है। खासी पाइन की मर्त्यता दर सबसे पहले लगभग 20 साल पहले उखरुल और चिंगाई उप-मंडल में दर्ज की गई थी और यह केवल कुछ खासी पाइन के पेड़ों तक ही सीमित थी।

2008 में, पूरे उखरुल जिले को इस समस्या से प्रभावित होने की सूचना मिली थी। पाइन की मर्त्यता दर का आकलन करने के लिए मणिपुर और मेघालय के विभिन्न पाइन उत्पादक क्षेत्रों में सर्वेक्षण किया गया। सर्वेक्षण से पता चला कि मणिपुर में अन्य स्थानों की तुलना में उखरूल में बीमारी का प्रतिशत तुलनात्मक रूप से अधिक था।

लक्षण:

रोग विकास के विभिन्न चरणों के लिए प्राकृतिक स्थिति में पिनस केसिया में लक्षण विकास का अध्ययन किया गया था। शुरूआती लक्षणों में पाइन की सुइयों का पीला पड़ना, उसके बाद डाईबैक का बढ़ना और डाईबैक का नीचे की ओर बढ़ना शामिल था। फल लगने के बाद के चरणों में कुछ रोगग्रस्त पेड़ों पर कवक का शरीर देखा गया।

शिलांग में पाइन के पेड़ों की मर्त्यता
(Mortality of Pine in Shillong)



मोरोम, मणिपुर में पाइन के पेड़ों की मर्त्यता
(Symptoms of pine mortality at Morom, Manipur)

आइसोलेशन (Isolation of causal organisms)

संक्रमित नमूनों को अलग-अलग पेपर बैग में प्रयोगशाला में लाया गया और एक रेफ्रिजरेटर में संग्रहीत किया गया। संग्रह के एक या दो दिनों के भीतर रोग नमूनों से कारण जीव का अलगाव किया गया। कवक के अलगाव और रखरखाव के लिए नियमित संस्कृति मीडिया का उपयोग किया जा रहा था। विभिन्न रोग नमूनों से अलग किए गए कवक की शुद्ध संस्कृति की पहचान, उनके सांस्कृतिक और रूपात्मक लक्षणों के आधार पर, जहां भी संभव हो, प्रजातियों के स्तर तक करने का प्रयास किया गया था।

पहचान (Identification)

रोगग्रस्त नमूनों से पृथक कवक की शुद्ध संस्कृति की पहचान उनके सांस्कृतिक और रूपात्मक लक्षणों के आधार पर करने का प्रयास किया गया था। विस्तृत रूपात्मक अध्ययन के लिए दस दिन पुरानी शुद्ध संस्कृति का उपयोग किया गया था। संरोपण करने वाली सुई डालकर कल्चर से प्राप्त मायसेलिया वृद्धि के टुकड़ों को स्लाइड में दिया गया और लैक्टोफेनॉल कपास में स्टैन करके अर्ध-स्थायी बनाने के लिए नेल पॉलिश से सील किया गया। इस प्रकार तैयार किए गए माउंट को यौगिक माइक्रोस्कोप के तहत देखा गया। रूपात्मक विशेषताएं दर्ज की गईं, माप किए गए और माइक्रोफोटोग्राफ लिए गए।

मेघालय और मणिपुर के इलाकों से कवक प्रजातियों की पहचान

क्रम संख्या	फंगल जीनस की पहचान	
	मेघालय (Meghalaya)	मणिपुर (Manipur)
1.	*पेनिसिलियम एसपी (Penicillium sp.)*	*पेनिसिलियम एसपी (Penicillium sp.)*
2.	*मोनिलिया एसपी (Monilia sp.)*	*म्यूकर एसपी (Mucor sp).*
3.	*ट्राइकोडर्मा एसपी (Trichoderma sp.)*	*ट्राइकोडर्मा एसपी (Trichoderma sp.)*
4.	*क्लैडोस्पोरियम एसपी.(Cladosporium sp.)*	*क्लैडोस्पोरियम एसपी.(Cladosporium sp)*
5.	*फ्यूजेरियम एसपी (Fusarium sp.)*	*फ्यूजेरियम एसपी (Fusarium sp.)*
6.	*वर्टिसिलियम एसपी (Verticillium sp.)*	*वर्टिसिलियम एसपी (Verticillium sp.)*
7.	*ग्लियोमैस्टिक्स एसपी (Gliomastix sp.)*	*कनिंघमेला एसपी (Cunninghumela sp.)*
8.	*म्यूकर एसपी (Mucor sp.)*	*ओडोसेफेलॉन एसपी.(Oedocephalon sp.)*
9.	*ह्यूमिकोला एसपी (Humicola sp.)*	*एक्टिनोम्यूकोर एसपी (Actinomucor sp.)*
10.	*पेस्टालोटिओप्सिस एसपी (Pestalotiopsis sp.) Wood & needle*	*पेस्टालोटिओप्सिस एसपी (Pestalotiopsis sp.)*
11.	*डोराटोमाइसेस एसपी (Doratomyces sp.)*	*पपुलरिया एसपी (Papularia Sp.)*
12.		*चीटोमियम एसपी (Cheatomium sp.)*
13.		*एब्सिडिया एसपी (Absidia sp.)*

शिलांग के नमूनों से ग्यारह कवक प्रजातियों और मणिपुर से तेरह प्रजातियों की पहचान की गई।

परिणाम

फ़ोमोटोप्सिस पेनिकोला अक्सर सड़े हुए तने से अलग हो जाता था। इसलिए, यह खासी पाइन की मर्त्यता से जुड़ा हुआ है। शुरूआती लक्षणों में पाइन की सुइयों का पीला पड़ना, उसके बाद डाईबैक का बढ़ना और डाईबैक का नीचे की ओर बढ़ना शामिल था। फलने की बाद की अवस्था में कुछ रोगग्रस्त पेड़ों पर *फ़ोमिटोप्सिस पेनिकोला* कवक देखा गया। शिलांग के रोगग्रस्त नमूनों से अलग किए गए ग्यारह कवक की पहचान की गई और तेरह कवक *पेस्टालोटिओप्सिस* और *फोमिटोप्सिस पेनिकोला* को मणिपुर और मेघालय में अधिकांश रोगग्रस्त पेड़ों से जुड़ा पाया जाता है।

पांच उपचारों (प्रत्येक उपचार के लिए 5 पौधे) में 25 पौधों में 2 कवक नाशकों और 2 जैव नियंत्रण (ट्राइकोडर्मा हर्ज़ियानम और ट्राइकोडर्मा विरिडी) का उपयोग करके नियंत्रण प्रयोगों के परिणाम सामने रखे गए। प्रायोगिक परीक्षण से डेटा का संग्रह समय के नियमित अंतराल में किया गया था और बायोकंट्रोल एजेंट *ट्राइकोडर्मा हार्ज़ियानम* (200 पीपीएम) के बाद 0.2% की दर से बाविस्टिन को रोग के आगे प्रसार को रोकने में प्रभावी पाया गया।

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ऑरेंज ड्रिंकर (*यूथ्रिक्स लाएटा*) का *डलबर्जिया शीसू* में संक्रमण और जीवविज्ञान

अरबिन्द डेका, बिजुमोनि कलिता दत्ता,
डॉ. प्रसून कर्माकर एवं अक्षय मिश्रा
भावाअशिप - वर्षा वन अनुसंधान संस्थान, जोरहाट, असम

सारांश
वर्षा वन अनुसंधान संस्थान, जोरहाट, असम में शीशम (*डलबर्जिया शीसू* रॉक्सब) पर ऑरेंज ड्रिंकर, *यूथ्रिक्स लाएटा* (वॉकर, 1855) (लेपिडोप्टेरा: लासिओकैम्पिडे) का संक्रमण और इसका जीव विज्ञान का अध्ययन किया गया है। अध्ययन में यह पाया गया है कि मादा 200-232 अंडों की कुल उर्वरता के साथ नये तने पर 13-17 गोलाकार अंडे देती है। अंतिम इंस्टार लार्वा अलग-अलग पैटर्न के साथ भूरे से राख रंग के और लंबाई में 6.7-9.5 सें.मी. होते है । प्यूपा 2.6 सें.मी. लंबा, भूरा और तने से मजबूती से जुड़े एक सफेद कोकून के अंदर होता है । कीट एक वर्ष में चार पीढ़ियां पूरी करती है । नर्सरी में बीज अंकुरण अवस्था के दौरान *ई. लाएटा* लार्वा गंभीर रूप से *डी. शीसू* को नष्ट कर देता है, जिससे पौधा सूख जाता है। *ई. लाएटा* लार्वा ने *डी. शीसू* पौधा ('टीएसटी-1') में 10-75.26% नुकसान पहुंचाता है । *डी. शीसू* पौधा ('टीएसटी-2') में *ई. लाएटा* लार्वा द्वारा उच्चतम प्रतिशत क्षति (75.26%) करता है ।

परिचय
डलबर्जिया शीसू (रोक्सब) शीशम भारतीय उपमहाद्वीप के इमारती लकड़ी के पेड़ की एक महत्वपूर्ण प्रजाति है, जो औसतन समुद्र तल से 900-1300 मीटर की ऊंचाई पर पाया जाता है। *डी. शीसू* का उपयोग शेल्टरबेल्ट, विंडब्रेक, चाय, कॉफी के बागानों और आम के बागों में छायादार पेड़ के रूप में भी उपयोग किया जाता है । *डी. शीसू* की छाल, पत्तियों और बीजों में कृमिनाशक, ज्वरनाशक, एनाल्जेसिक और कामोत्तेजक गुण होते हैं। इसलिए, इन पौधों के हिस्सों का पारंपरिक रूप से विभिन्न रोगों के इलाज के लिए उपयोग किया जाता है । हाल के वर्षों में, *डी. शीसू* की उत्पादकता में प्रमुख कीट, जैसे *एस्कोटिस इन्फिक्सारिया* वॉक, *डाइकोमेरिस एरिडांटिस* मेयर और *प्लेकोप्टेरा रिफ्लेक्सा* गनी के प्रकोप के कारण गिरावट आई है ।
ऑरेंज ड्रिंकर, (यूथ्रिक्स लाएटा वॉकर),) (1855लेपी(लासियोकैंपिडे :डोप्टेरा-, डी .शीसू और डी . लैटिफ़ोलियाका एक कीट है । यह बांग्लादेश, नेपाल, उत्तर भारत और पाकिस्तान से रिपोर्ट किया गया है। हालाँकि, डी .शीसू पर ई लाएटा डिविसा के विकासात्मक मापदंडों और क्षति . की प्रकृति पर व्यापक डेटा का अभी भी अभाव है। इसलिए, वर्षा वन अनुसंधान संस्थान परिसर, जोरहाट, असम में डी. शीसू पर ई. लाएटा डिविसा के जीव विज्ञान और क्षति की प्रकृति पर की गई टिप्पणियों को इस लेख में एक नए रिकॉर्ड के रूप में वर्णित किया गया है। भा.वा.अ.शि.प-वर्षा वन अनुसंधान संस्थान, जोरहाट, असम 26)° 46′ 51.7″ उत्तर अक्षांश, 94° 17′) में डी . शीसू पौधों पर पत्ते नष्ट करने वाले कीटों की और क्षति की प्रकृति का आकलन करने के लिए क्षेत्र सर्वेक्षण किया गया था । वर्षा वन अनुसंधान संस्थान, जोरहाट, एक प्रमुख अनुसंधान संस्थान है जो भारतीय वानिकी अनुसंधान और शिक्षा परिषद की एक शाखा है और उत्तर पूर्व भारत के

वन अनुसंधान विस्तार के लिए समर्पित है। कैटरपिलर को डी .शीसू नर्सरी से एकत्र किया गया था और वयस्क होने तक प्रयोगशाला में कांच के जार के अंदर ताजा डी .शीसू पत्तियों पर पाला गया था। प्रकाशित साहित्य की मदद से पतंगों की पहचान की गई और उन्हें वर्षा वन अनुसंधान संस्थान, जोरहाट के कीटालय में संरक्षित किया गया। भारत में शीशम डलबर्जिया शीसू (रॉक्सबी .पर ई असम लाएटा) की उपस्थिति का दस्तावेजीकरण करने वाला पहला राज्य असम है। नर्सरी में डी . शीसू पौधो को लाएटा की लार्वा गंभीर रूप से नष्ट कर देता है (1 चित्र)। अंतिम इंस्टार लार्वा आदतन रात्रिचर होते हैं और अंकुरित पत्तियों को ऊपर से नीचे तक तेजी से खाते हैं। गंभीर रूप से संक्रमित पौधे संक्रमण के दिनों के भीतर सूख जाते हैं। 10-7 प्रारंभिक इंस्टार लार्वा सामूहिक निवास करते हैं, और बाद के चरण एकान्त में रहते हैं।

संक्रमण (%) का आकलन सूत्रों का उपयोग करके किया गया :

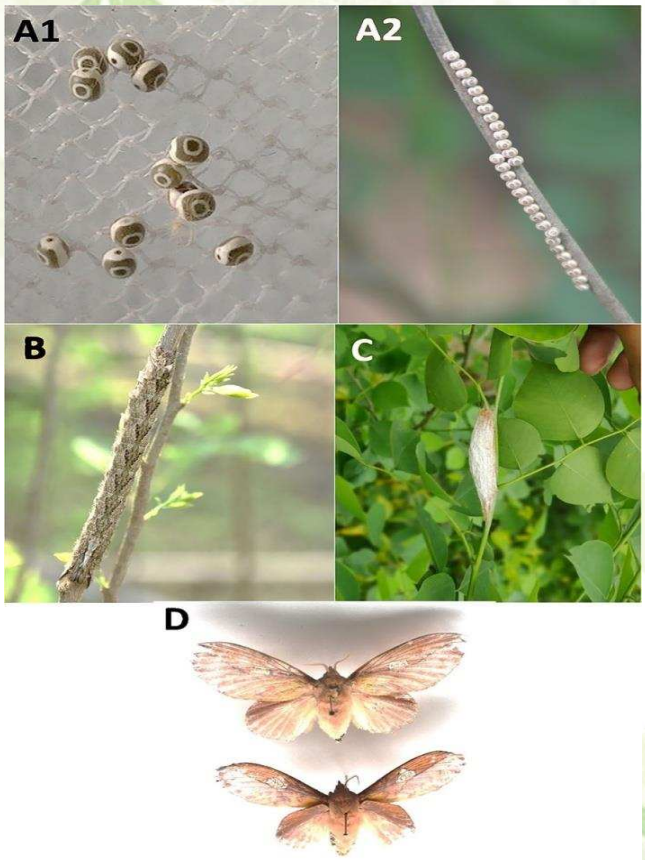
$$\text{संक्रमण (\%)} = \frac{\text{पौधों की संख्या x 100 संक्रमण (\%)}}{\text{सर्वेक्षण किए गए पौधों की कुल संख्या}}$$

डी. शीसू पौधा ('टीएसटी-1') में *ई. लाएटा* लार्वा द्वारा उच्चतम प्रतिशत क्षति 10-75.26% पहुंचाता है (चित्र 1) लेकिन *डी. शीसू* पौधा ('टीएसटी-2') में (75.26%) दिखाई देता है ।

चित्र 1. *डलबर्जिया शीसू* प्लस वृक्ष 'टीएसटी-1' पौधों पर *यूथ्रिक्स लाएटा* के कारण पतझड़

तालिका 1: *डलबर्जिया शीसू* के विभिन्न प्लस पेड़ों पर *यूथ्रिक्स लाएटा* के कारण होने वाली क्षति (%)

डी. शीसू प्लस	पेड़ों की कुल संख्या	पौधों का क्षतिग्रस्त	पौधे हानि (%)
एमडीजे-2	167	44	26.35
टीडीटी-1	52	10	19.23
टीडीटी-2	50	5	10.00
टीएसटी-1	97	73	75.26
टीएसटी-2	150	35	23.33



चित्र 2 A1-A2 = अंडे, बी = अंतिम इंस्टार लार्वा, सी = प्यूपा, डी = यूथ्रिक्स लाएटा की महिला वयस्क

शुरुआती इंस्टार्स (पहला और दूसरा) लंबाई में 5 मिमी से 21 मिमी थे। वे अलग-अलग नारंगी और काले धब्बों के साथ राख-ग्रे रंग के थे। शुरुआती इंस्टार लार्वा के शरीर पर लंबे भूरे रंग के बाल उभरे हुए देखे गए। बाद के इंस्टार लार्वा अलग-अलग पैटर्न के साथ भूरे से राख भूरे रंग के थे और मेजबान पौधे की शाखाओं के साथ छिपे हुए थे (चित्र 2)। अंतिम इंस्टार लार्वा की लंबाई 6.7-9.5 सेमी मापी गई। लार्वा बेलनाकार, विरल होते हैं । सावधानीपूर्वक अवलोकन से पता चला कि *ई. लाएटा* में बाल होते हैं और मेसोथोरैक्स और आठवें पेट खंड पर विशिष्ट सेट होते हैं। प्यूपा 2.6 सेमी लंबा, भूरे रंग का होता है और एक सफेद कागजी कोकून के अंदर तने से मजबूती से जुड़ा होता है (चित्र 2)। वयस्क हल्के लाल-नारंगी रंग के होते हैं जिनमें द्विपेक्टिनेट एंटीना होते हैं। मादाएं नर से बड़ी होती हैं, उनके पंखों का फैलाव 6.2 सेमी होता है। आगे के पंख पत्ती जैसे होते हैं जिन पर एक जोड़ी विशिष्ट सफेद डिस्कल धब्बे होते हैं (चित्र 2)।

नर्सरी से एकत्रित *ई. लाएटा* लार्वा का संवर्धन 27 ± 2 डिग्री सेल्सियस, 70 ± के तापमान पर कांच के जार में कई पीढ़ियों तक *डी. शीसू* की ताजी पत्तियों पर रखा गया । 5% सापेक्ष आर्द्रता और 16L: 8D फोटोपीरियड। अंडे के ऊष्मायन, लार्वा और प्यूपा अवधि पर *ई. लाएटा डिविसा* के जैविक पैरामीटर; मादा की वयस्कों की दीर्घायु, डिंबोत्सर्जन अवधि और *ई. लाएटा* की कुल उर्वरता डी. शीसू पेड़ की पत्तियों पर दर्ज की गई। शीशम पेड़ पर *ई. लाएटा* के अंडे की चेन, लार्वा और प्यूपा की अवधि क्रमशः 6 से 8 दिन, 35-37 दिन और 11-12 दिन तक होती है। पहले इंस्टार, दूसरे इंस्टार, तीसरे इंस्टार, चौथे इंस्टार और पांचवें इंस्टार लार्वा की अवधि क्रमशः 6, 6, 8, 7 और 10 दिन होती है । *ई. लाएटा* अपरिपक्व चरणों की कुल विकास अवधि 52 से 57 दिनों तक होती है । परीक्षण किए गए शीशम पेड़ पर मादा *ई. लाएटा* की दीर्घायु और ओविपोजिशन अवधि क्रमशः 14 से 16 दिन और 10-12 दिन तक होती है । *ई. लाएटा* मादा वयस्कों की कुल उर्वरता 200 से 232 अंडे/मादा तक होती है । इस कीट ने एक वर्ष में चार पीढ़ियाँ पूरी कर लेती है । असम में *ई. लाएटा* के गंभीर संक्रमण से संकेत मिलता है कि यह कीट निकट भविष्य में *डी. शीसू* नर्सरी और वृक्षारोपण में एक गंभीर संक्रमण का कारण बन सकता है। इस कीट की जनसंख्या की गतिशीलता निर्धारित करने के लिए सभी शीशम नर्सरी और बागानों में फील्ड सर्वेक्षण की आवश्यकता है। इसके अलावा, प्रबंधन रणनीतियों पर शोध से इसकी घटनाओं को कम किया जा सकता है ।

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तात्री- उत्तर पूर्व भारत का एक महत्वपूर्ण औषधीय वृक्ष

नादा तादी
वैज्ञानिक-बी
भा.वा.अ.शि.प.-वर्षा वन अनुसंधान संस्थान
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद,
देववन, जोरहाट-785001, असम

तात्री (*Rhus semialata* Murray, *R. Chinenesis* Mill and *R. javanica* Linn.) औषधीय गुणों से भरपूर एक महत्वपूर्ण वृक्ष प्रजाति है। इसे आमतौर पर चाइनीज सुमैक और नटगैल ट्री के नाम से भी जाना जाता है। स्थानीय रूप से इसे विभिन्न नामों से जाना जाता है जैसे तात्री (हिंदी), तामो (अपातानी), तांगोंग (आदि), इमोशी (माओ), हेइमांग (मणिपुरी), खावम्हा (मिज़ो), भाकी अमिलो या चुक अमिलो (नेपाली), नागा तेंगा (असमिया) आदि । भारत में यह अरुणाचल प्रदेश, असम, मणिपुर, मेघालय, नागालैंड, सिक्किम, पश्चिम बंगाल आदि राज्यों में 3,000-7,000 फीट की ऊंचाई पर बाहरी हिमालय पर्वतमाला की पहाड़ियों में उगता है।

तात्री एक पर्णपाती खुला फैलने वाला छोटा पेड़ है जो 15 से 25 फीट की ऊंचाई तक बढ़ सकता है। इनके मुकुट का फैलाव 15 से 20 फीट तक होता है, जिसमें गोल मुकुट (crown) आकार, मध्यम मुकुट घनत्व और मध्यम विकास दर होती है। फूल सफेद से मलाईदार सफेद रंग के होते हैं, फल गोल, चपटे और नारंगी से लाल रंग के होते हैं। बीज कठोर एवं भूरे काले रंग के होते हैं।

इसकी वृद्धि के लिए 13-37 डिग्री सेल्सियस का तापमान और 2000 से 3000 मिलीमीटर का औसत वर्षा आदर्श होता है। यह आसानी से शुष्क से मध्यम नमी, मध्यम से उच्च कार्बनिक पदार्थ वाली मिट्टी, pH रेंज 4.2 से 5.8 के साथ पूर्ण सूर्य से आंशिक छाया की स्थिति में विकसित हो सकता है। लेकिन मिट्टी में जल निकास की व्यवस्था ठीक नहीं हो तो ऐसी मिट्टी उनके लिए उपयुक्त नहीं होती है। इनका प्रवर्धन मुख्यतः बीजों द्वारा किया जाता है

इनके फल विभिन्न पोषक तत्वों और खनिजों से भरपूर होते हैं। फलों के गूदे का उपयोग भोजन में खट्टापन लाने के लिए मसाले के रूप में किया जाता है। नागालैंड और मणिपुर जैसे राज्यों में, गूदे का उपयोग हर्बल चाय के रूप में किया जाता है और यह पाचन में सुधार करने में सहायक माना जाता है। इसके अलावा स्थानीय लोग फलों का उपयोग चटनी और अचार बनाने में भी करते हैं। चीन में पत्तियों से कम अल्कोहल वाले ताज़ा पेय, सिरका और सोया सॉस जैसे पोषक तत्वों से भरपूर खाद्य उत्पाद विकसित किए गए हैं।

टैनिन भरपूर पत्तियों से भूरा रंग का डाई प्राप्त होती है। पत्ती के गूदे का उपयोग नीली डाई बनाने में किया जाता है जिसे स्याही के रूप में इस्तेमाल किया जा सकता है। बीज के तेल का उपयोग मोमबत्तियाँ बनाने के लिए किया जाता है।

तात्री की पत्तियां विरेचक मानी जाती हैं और रक्त संचार को उत्तेजित करती हैं। इनका उपयोग हेमोप्टाइसिस, सूजन, लैरींगाइटिस, पेट दर्द, दर्दनाक फ्रैक्चर, शुक्राणुनाशक, सांप के काटने और दस्त के उपचार में किया जाता है। फलों का उपयोग पेट का दर्द, दस्त, पेचिश, पीलिया और हेपेटाइटिस के इलाज के लिए किया जाता है। बीजों का उपयोग खांसी, पेचिश, बुखार, पीलिया, हेपेटाइटिस, मलेरिया और गठिया के इलाज के लिए किया जाता है। जड़ का उपयोग दस्त, शुक्राणुनाशक, मलेरिया, एंटीट्यूसिव, एनासारका के उपचार, पीलिया और सांप के काटने के इलाज में किया जाता है।

इनके पत्तियों से प्राप्त होने वाली चीनी गॉल (chinese galls) को एंटीसेप्टिक, एंटीफ्लॉजिस्टिक, एस्ट्रिंजेंट और हेमोस्टैटिक जैसे औषधीय गुणों के लिए जाना जाता है। इसका व्यापक रूप से चीनी चिकित्सा में दस्त, मधुमेह, खून के साथ लगातार खांसी, स्वतःस्फूर्त पसीना, उरोरिया, खूनी थूक, जलन, बवासीर, मौखिक रोग, बुखार, मलेरिया, सूजन, विषाक्तता, घाव, त्वचा संक्रमण, मलाशय और आंतों का कैंसर के इलाज के लिए उपयोग किया जाता है।

प्राकृतिक उपचार में औषधीय और सुगंधित पौधों का महत्व: अगरवुड

सोनकेश्वर शर्मा
वैज्ञानिक-बी
भा.वा.अ.शि.प.-वर्षा वन अनुसंधान संस्थान
भारतीय वानिकी अनुसंधान एवं शिक्षा परिषद,
देववन, जोरहाट-785001, असम

प्राचीन काल से ही औषधीय पौधे दुनिया भर में, मानव स्वास्थ्य देखभाल प्रणाली का एक अनिवार्य हिस्सा रहे हैं। इस पौधे में चिकित्सीय गुण, और यह मनुष्यों तथा जानवरों की बीमारियों को कम करने और महत्वपूर्ण उपचार प्रदान करने की क्षमता होती है। हर्बल चिकित्सा की परंपरा प्राचीन सभ्यताओं से चली आ रही है, और अभी भी आधुनिक स्वास्थ्य देखभाल प्रथाओं का अभिन्न अंग बनी हुई है। यह मान्यता है कि, कई पौधे और उसके हिस्से औषधीय गुणों से भरपूर हैं और उनका अर्क कई आधुनिक दवाओं के आधार के रूप में काम करता है। उदाहरण के लिए, दर्द से राहत के लिए मॉर्फिन, उच्च रक्तचाप के लिए रिसर्पाइन, और कैंसर के इलाज के लिए टैक्सोल और विंका एल्कलॉइड। 2600 ईसा पूर्व में, मेसोपोटामिया के लोग संक्रामक रोगों के लिए सरू, लिकोरिस, लोहबान और खसखस जैसे पौधों का उपयोग करते थे, यह प्रथा आज भी कॉमिफोरा वाइटी, कप्रेसस सेपरविरेन्स, सेड्रस एसपीपी, ग्लाइसिराइजा ग्लबरा और पापावर सोम्निफेरम जैसी प्रजातियों के साथ देखी जाती है। पीढ़ियों के ज्ञान में निहित ये पौधे, पारंपरिक, स्वदेशी और लोक औषधियों का सार प्रस्तुत करते हैं, जो दुनिया भर में अमूल्य स्वास्थ्य देखभाल संसाधनों के रूप में काम करते हैं। विश्व स्वास्थ्य संगठन (डब्ल्यूएचओ) के अनुसार, वैश्विक आबादी का लगभग 75-80%, विशेष रूप से विकासशील देशों में, अपनी प्राथमिक स्वास्थ्य देखभाल आवश्यकताओं को पूरा करने के लिए हर्बल चिकित्सा पर निर्भर हैं। औषधीय पौधे अपनी सांस्कृतिक स्वीकृति, मानव शरीर के साथ अनुकूलता और न्यूनतम दुष्प्रभावों के कारण इन क्षेत्रों में प्राथमिक स्वास्थ्य देखभाल की आधारशिला हैं। विकासशील देशों में वानस्पतिक व्यापार फलता-फूलता है, भारत का वानस्पतिक व्यापार सालाना लगभग 10 बिलियन अमेरिकी डॉलर का होता है, और कुल निर्यात 1.1 बिलियन अमेरिकी डॉलर का होता है। भारत में 8000 से अधिक औषधीय पौधों की प्रजातियों के साथ पारंपरिक हर्बल चिकित्सा ज्ञान का विशाल भंडार है। हालाँकि, चीन के विपरीत, मानकीकृत हर्बल दवाओं और फॉर्मूलेशन की कमी के कारण भारत अभी तक इस संपत्ति का पूरी तरह से उपयोग नहीं कर पाया है। हिमालय में, औषधीय पौधे एक महत्वपूर्ण भूमिका निभाते हैं, जिसमें प्रजातियों के दस्तावेजीकरण, उनके उपयोग और वितरण पर ध्यान केंद्रित किया जाता है। भारतीय औषधीय वनस्पतियों और उनकी जैविक गतिविधियों पर प्रचुर मात्रा में जानकारी उपलब्ध है। शोधकर्ताओं ने इन-विट्रो प्रसार और संरक्षण के लिए प्रोटोकॉल विकसित करने के लिए कई लुप्तप्राय औषधीय पौधों की प्रजातियों पर समीक्षा की है। इन प्रयासों से पोडोफिलम हेक्सांद्रम, नार्डोस्टैचिस जटामांसी, रयूम इमोडी, वेलेरियाना वालिची और एकोनिटम हेटरोफिलम जैसी प्रजातियों के लिए इन-विट्रो कल्चर प्रोटोकॉल के मानकीकरण को बढ़ावा मिला है।

विश्व स्तर पर, स्वास्थ्य देखभाल में प्राथमिकता धीरे-धीरे बीमारी से कल्याण की ओर, उपचार से शीघ्र पता लगाने और रोकथाम की ओर, और सामान्य दृष्टिकोण से अनुरूप चिकित्सा की ओर स्थानांतरित हो रही है। वैश्विक स्तर पर, पौधे आधारित वैकल्पिक दवाएं धीरे-धीरे लोकप्रियता हासिल कर रही हैं। चूंकि प्राकृतिक उत्पादों को आधुनिक फार्मास्यूटिकल्स की तुलना में कम महंगा और कम दुष्प्रभाव वाला माना जाता है, इसलिए वे वैश्विक बाजार के विस्तार को बढ़ावा दे रहे हैं। एक्ज़िम बैंक के अनुमान के अनुसार, औषधीय पौधों का वैश्विक वार्षिक व्यापार 60 बिलियन अमेरिकी डॉलर से अधिक है, जिसमें भारत सालाना 7% की वृद्धि दर के साथ इस व्यापार में 2300 करोड़ रुपये का योगदान देता है। औषधीय और सुगंधित पौधों (एमएपी) के प्रमुख वैश्विक व्यापार केंद्रों में चीन, जर्मनी, फ्रांस, इटली, जापान, स्पेन, यूनाइटेड किंगडम और संयुक्त राज्य अमेरिका शामिल हैं। ये औषधीय और सुगंधित पौधें उन पौधों की प्रजातियों को संदर्भित करते हैं जो उनके चिकित्सीय गुणों या उनके सुगंधित यौगिकों के लिए मूल्यवान हैं, जिनका उपयोग अक्सर दवा, इत्र, सौंदर्य प्रसाधन, पाक और सांस्कृतिक प्रथाओं सहित विभिन्न अनुप्रयोगों में किया जाता है। डब्ल्यूएचओ का अनुमान है कि औषधीय पौधों के उत्पादों की वैश्विक मांग सालाना 15 से 25 अरब डॉलर के बीच है, जिसका अनुमानित मूल्य 2050 तक 5 ट्रिलियन डॉलर से अधिक होगा। यह विकास प्रक्षेपवक्र 15% से 25% की वार्षिक मांग में वृद्धि को दर्शाता है। न्यूट्रास्युटिकल क्षेत्र, जिसमें एफडीए मानकों को पूरा करने के लिए आहार अनुपूरकों के साथ हर्बल दवाओं का संयोजन शामिल है, तथा जिसका मूल्य वर्तमान में 5.1 बिलियन अमेरिकी डॉलर है।

भारत दुनिया के 17 मेगा जैव विविधता वाले देशों में से एक है, जिसमें 45,000 से अधिक पौधों की प्रजातियाँ मौजूद हैं। इनमें से, 7,500 पौधे 4,635 समुदायों के लिए मानव और पशु चिकित्सा आवश्यकताओं दोनों के लिए विविध उद्देश्यों की पूर्ति करते हैं। अपने विविध जलवायु क्षेत्रों के कारण भारत की पुष्प समृद्धि अद्वितीय है। आयुर्वेद, सिद्ध और यूनानी प्रणालियों में निहित एक मजबूत विरासत के साथ, भारत लंबे समय से समग्र स्वास्थ्य के लिए औषधीय पौधों का उपयोग करता रहा है। इसके अतिरिक्त, भारत प्रसंस्कृत संयंत्र उत्पादों और कच्चे एमएपी के निर्यात में एक प्रमुख खिलाड़ी है। अकेले 1994-95 में, भारत ने पौधे-आधारित दवा निर्यात से 53,219 मिलियन अमेरिकी डॉलर और आवश्यक तेलों से 13,250 मिलियन अमेरिकी डॉलर कमाए। भारत में 15 विशिष्ट कृषि-जलवायु क्षेत्र शामिल हैं, जो समृद्ध वनस्पति विविधता को बढ़ावा देते हैं। देश फूलों के पौधों की 17,000-18,000 प्रजातियों का घर है, जिनमें से 6,000-7,000 में औषधीय गुण हैं जो आयुर्वेद, सिद्ध, यूनानी, चरक संहिता और होम्योपैथी जैसी पारंपरिक प्रणालियों में प्रलेखित हैं। इसके अलावा, लगभग 960 औषधीय पौधों की प्रजातियाँ व्यापार में सक्रिय रूप से शामिल हैं, जिनमें से 178 प्रजातियों की वार्षिक खपत 100 मीट्रिक टन से अधिक है। भारत अपनी उल्लेखनीय जैव विविधता के लिए विश्व स्तर पर पहचाना जाता है, जिसमें पूर्वोत्तर क्षेत्र एक प्रमुख हॉटस्पॉट के रूप में खड़ा है। पूर्वी हिमालय और इंडो-बर्मा क्षेत्र के बीच स्थित, पूर्वोत्तर भारत लुभावने परिदृश्य और विविध पारिस्थितिकी तंत्र प्रदान करता है, जो प्रकृति प्रेमियों और शोधकर्ताओं दोनों की रुचि को आकर्षित करता है। जंगलों, घास के मैदानों, आर्द्रभूमियों

और उच्च ऊंचाई वाले घास के मैदानों जैसे असंख्य आवासों को शामिल करते हुए, यह क्षेत्र असाधारण जैव विविधता को प्रदर्शित करता है। इसकी समृद्ध वनस्पति में दुर्लभ और स्थानिक किस्मों सहित कई पौधों की प्रजातियां शामिल हैं, जो इसकी पारिस्थितिक विशिष्टता में योगदान करती हैं। उल्लेखनीय हैं एमएपी प्रजातियां और मूल्यवान लकड़ी के संसाधन जो पूर्वोत्तर भारत की वनस्पति संपदा को समृद्ध करते हैं, जिससे यह प्राकृतिक आश्चर्यों का खजाना बन जाता है। इस क्षेत्र के सबसे उल्लेखनीय पौधों में से एक अगरवुड है, जो अपने समृद्ध ऐतिहासिक, सांस्कृतिक और आर्थिक महत्व के लिए प्रसिद्ध है।

अगरवुड के रूप में जाना जाने वाला मूल्यवान सुगंधित गहरे रंग का राल वाला हर्टवुड एक्विलेरिया प्रजाति से उत्पन्न होता है। भारत तीन एक्विलारिया प्रजातियों का घर है, अर्थात् ए. मैलाकेंसिस लैम., ए. खसियाना हॉल, और ए. मैक्रोफिला मिक, जिसमें ए. मैलाकेंसिस विशेष रूप से उल्लेखनीय है। एक्विलारिया की 13 ज्ञात सुगंधित राल-उत्पादक प्रजातियों में से, ए. मैलाकेंसिस लैम्क एक है, जो थाइमेलिएसी परिवार में आता है। अपनी वैश्विक लुप्तप्राय स्थिति के बावजूद, ए. मैलाकेंसिस पूर्वोत्तर भारतीय क्षेत्र में फलता-फूलता है, जहां इसकी खेती और व्यापार दशकों से किया जाता रहा है। अपनी मनमोहक खुशबू के लिए प्रतिष्ठित, अगरवुड का उपयोग पारंपरिक चिकित्सा, इत्र और धार्मिक अनुष्ठानों में किया जाता है, जो सांस्कृतिक विरासत के एक पोषित हिस्से का प्रतीक है। अगरवुड इस क्षेत्र में गहरा सांस्कृतिक महत्व रखता है, जिसे अक्सर अनुष्ठानों और समारोहों में प्रमुखता से दिखाया जाता है। यह मुख्य रूप से दक्षिण पूर्व एशिया में पाया जाता है, जिसमें पूर्वोत्तर भारत के उपोष्णकटिबंधीय और उष्णकटिबंधीय वर्षावन शामिल हैं। मलेशिया, इंडोनेशिया, और हिमालय की तलहटी से पापुआ न्यू गिनी तक फैला हुआ है। एक्विलेरिया के पेड़ विशिष्ट फफूंद संक्रमणों या पर्यावरणीय तनाव के जवाब में अगरवुड राल का उत्पादन करते हैं। यह राल, जिसे अगरवुड या ऊद के नाम से जाना जाता है, हार्टवुड को एक विशिष्ट और अत्यधिक बेशकीमती खुशबू से भर देता है। पूर्वोत्तर भारत के विविध आवासों में, हरे-भरे सदाबहार जंगलों से लेकर ऊबड़-खाबड़ पहाड़ियों तक, अगरवुड के पेड़ विभिन्न वनस्पतियों और जीवों को आश्रय प्रदान करके जैव विविधता को बढ़ावा देते हैं। अगरवुड का निर्माण असंख्य कारकों से प्रभावित होता है, जिसमें पर्यावरणीय तनाव, फंगल इंटरैक्शन, जलवायु स्थितियां, मिट्टी की संरचना और आनुवंशिक विविधताएं शामिल हैं। यह जटिल परस्पर क्रिया अगरवुड की गुणवत्ता और मात्रा को निर्धारित करती है, जो इसे एक अद्वितीय और अमूल्य सुगंधित खजाना बनाती है।

স্ব- নিয়োজনত বনভিত্তিক উদ্যমিতাসমূহৰ ভূমিকা আৰু এই ক্ষেত্ৰত বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠানৰ কৰণীয়

ৰাজীৱ কুমাৰ কলিতা

মূৰব্বী বিজ্ঞানী, সম্প্ৰসাৰণ বিভাগ,

ভা.ৱ্.অ.শি.প. - বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠান, যোৰহাট

অসম এখন কৃষি প্ৰধান ৰাজ্য যদিও অসমৰ গ্ৰাম্য অৰ্থনীতিত বন ক্ষেত্ৰই যথেষ্ট অৱদান যোগাই আহিছে। অসমৰ প্ৰায় ৩৪.২১% ভূমি বন জংঘলেৰে আৱৰি আছে। এই বন জংঘলসমূহত আপুৰুগীয়া জীৱ-জন্তুৰ উপৰিও বহুতো মুল্যৱান উদ্ভিদ জাতীয় সম্পদেৰে ভৰি আছে। এই বন সমূহে অসম তথা উত্তৰ- পূৰ্বাঞ্চলৰ প্ৰাকৃতিক ভাৰসাম্য ৰক্ষা কৰাৰ উপৰিও মানুহৰ জীৱিকা আৰ্জনত যথেষ্ট গুৰুত্বপূৰ্ণ ভূমিকা পালন কৰি আহিছে। যদিও বিগত কেইবাদশকত বনভূমিৰ পৰিমাণ কমি আহিছে, তথাপিও কৃষিৰ পিছতেই বনক্ষেত্ৰই ৰাজ্যৰ অৰ্থনীতিত সমল যোগাই আহিছে। অসমৰ বনক্ষেত্ৰখনে স্বনিয়োজনত এটি গুৰুত্বপূৰ্ণ ভূমিকা পালন কৰা পৰিলক্ষিত হৈছে। অসমৰ বনভিত্তিক উদ্যমিতাসমূহৰ কিছু আভাস আৰু তাৰ লগতে বৰ্ষাৰণ্য প্ৰতিষ্ঠানৰ কেনেকুৱা অৱদান এই সকলো দিশ সামৰি নতুন প্ৰজন্মৰ সহায় হোৱাকৈ লেখাটি প্ৰস্তুত কৰা হ'ল।

১) বাঁহ- অসমৰ সেউজ সোণঃ

বাঁহ অসম তথা উত্তৰ পূৰ্বাঞ্চলৰ এবিধ গুৰিত্বপূৰ্ণ প্ৰাকৃতিক সম্পদ। সমগ্ৰ পৃথিৱীত প্ৰায় ১২৫০ বিধৰো অধিক প্ৰজাতিৰ বাঁহ পোৱা যায়। ইয়াৰে প্ৰায় ১৩৬ বিধ মান প্ৰজাতি আমাৰ ভাৰতবৰ্ষত পোৱা যায়। সমগ্ৰ ভাৰতৰ মুঠ প্ৰজাতিৰ ৬৫% ত কৈও অধিক প্ৰজাতি আমাৰ উত্তৰ পূৰ্বাঞ্চলত পোৱা যায়।উত্তৰ পূৰ্বাঞ্চলৰ গ্ৰাম্য অৰ্থনীতিত বাঁহে যথেষ্ট প্ৰভাৱ বিস্তাৰ কৰি আহিছে। আমাৰ এনে এখন ক্ষেত্ৰ নাই য'ত বাঁহৰ প্ৰয়োগ হোৱা নাই। আমাৰ সংগীত, সাহিত্য, লোকাচাৰ্, অৰ্থনীতি, ধৰ্মীয়, সাংস্কৃতিক , পৰিৱেশিক সকলোতে বাঁহৰ প্ৰভাৱ দেখিবলৈ পোৱা গৈছে। আমাৰ জংঘল তথা বাঁহবাৰীত উত্তম প্ৰজাতিৰ বাঁহ পোৱা যায়। আগতে বাঁহক "দুখীয়া মানুহৰ কাঠ" বুলি অভিহিত কৰা হৈছিল কিন্তু সেইদিন আৰু নাই। বাঁহ বৰ্তমান আভিজাত্যৰ আলংকৰিক সামগ্ৰীলৈ ৰূপান্তৰিত হৈছে। প্ৰতিদিনে বাঁহৰ নিত্য নতুন ব্যৱহাৰ পৰিলক্ষিত হৈ আহিছে। এতিয়ালৈকে বাঁহৰ প্ৰায় ১৫০০ বিধমান প্ৰয়োগ অৱগত হৈছে। ইমানবোৰ প্ৰয়োগ থকা বাবে বাঁহে স্বনিয়োজনত যথেষ্ট ইতিবাচক ভূমিকা পালন কৰি আহিছে। তাৰে কিছু কথা তলত আলোচনা কৰা হ'ল।

ক) বাঁহৰ বাণিজ্যিক পুলি বাগান তৈয়াৰঃ

উচ্চ উৎপাদনক্ষম সুস্থ-সৱল বাঁহ্পুলিৰ চাহিদা দিনক দিনে বাঢ়ি থকালৈ চাই বাণিজ্যিকভাৱে বাঁহৰ পুলিবাগান তৈয়াৰ কৰা সম্ভাৱনীয়তা যথেষ্ট বাঢ়ি যোৱা পৰিলক্ষিত হৈছে। এই ক্ষেত্ৰত বৰ্ষাৰণ্য প্ৰতিষ্ঠানে বহুবছৰ গৱেষণাৰ মূৰত জাতি, ভলুকা, কাক' আৰু মকাল প্ৰজাতিৰ ১৬ বিধ সঁচ উদ্ভাৱন কৰি উলিয়াইছে। এই সঁচবোৰ প্ৰতিষ্ঠানে ইতিমধ্যে ভাৰত তথা উত্তৰ- পূৰ্বাঞ্চলৰ বহুকেইটা প্ৰতিষ্ঠানলৈ হস্তান্তৰো কৰিছে। বাঁহ ৰোপনৰ বৰ্দ্ধিত ক্ষেত্ৰলৈ লক্ষ্য ৰাখি বাণিজ্যিকভাৱে বাঁহৰ পুলিবাগান তৈয়াৰ কৰিব পাৰি।

খ) বাণিজ্যিকভাৱে বাঁহৰ খেতিঃ

বাঁহৰ উৎপাদন তথা উৎপাদিকা বঢ়াবৰ বাবে বহল পৰিসৰত বৈজ্ঞানিকভাৱে বাণিজ্যিক ভিত্তিত বাঁহ খেতি কৰিব লাগিব। উদাহৰণস্বৰূপে অসমৰ গোলাঘাট জিলাৰ নুমলিগড়ত স্থাপন হোৱা "অসম জৈৱ ইন্ধন প্ৰাঃলিঃ" নামৰ উদ্যোগটি যেতিয়া সম্পূৰ্ণৰূপে উৎপাদনক্ষম হৈ উঠিব তেতিয়া ইয়াত বছৰি ৫ লাখ টন বাঁহৰ প্ৰয়োজন হ'ব। এই উদ্যোগটিয়ে বিশেষকৈ উজনি অসমলৈ বৃহৎ সম্ভাৱনা কঢ়িয়াই আনিবলৈ সক্ষম হৈছে। এই উদ্যোগক নিৰৱিছিন্নভাৱে বাঁহ যোগান ধৰিবলৈ হ'লে বহল পৰিসৰত বাঁহখেতি কৰাৰ প্ৰয়োজনীয়তা আহি পৰিছে। বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠানে ইতিমধ্যে উদ্যোগটিৰ এই প্ৰচেষ্টাত সহায়ৰ হাত আগবঢ়াই আহিছে।

গ) বাঁহৰ কয়লা প্ৰস্তুতকৰণঃ

বাঁহৰ পৰা অতি সহজতে কয়লা প্ৰস্তুত কৰিব পাৰি। কাঠ কয়লাৰ তুলনাত বাঁহ কয়লাৰ তাপশক্তিৰ পৰিমাণ বেছি। বাঁহ যিহেতু তুলনামূলকভাৱে বেছিকৈ বাঢ়ে আৰু চাৰি/ পাঁচ বছৰত কাটিব পাৰি, গতিকে বাঁহ কয়লাক এক প্ৰকাৰ পুনঃব্যৱহাৰ্য্য তাপ্শক্তিৰ উৎস হিচাপে গণ্য কৰিব পাৰি। বাঁহ কয়লাৰ প্ৰয়োগ অতি বিশাল।পানী শোধনৰ পৰা আৰম্ভ কৰি প্ৰসাধনৰ বিভিন্ন সামগ্ৰী, নিত্য ব্যৱহাৰ্য্য সামগ্ৰী তথা মাটিত সাৰ হিচাপেও প্ৰযোগ কৰিব পাৰি। বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠানে বাঁহ কয়লা প্ৰস্তুতকৰণ, ইয়াৰ পৰা 'ব্ৰিকেট' প্ৰস্তুতকৰণ আদি কৰি বিভিন্ন বিষয়ৰ ওপৰত গৱেষণা তথা উন্নয়নমূলক কাম কৰি আছে। কম মূলধন খটুৱাই অধিক উপাৰ্জন কৰিব পৰা এটা পথ হ'ল বাঁহ কয়লা প্ৰস্তুতকৰণ।

ঘ) বাঁহ পৰিশোধনঃ

সাধাৰণতে দেখা যায় যে যেতিয়া বিভিন্ন কামত বাঁহ ব্যৱহাৰ কৰা হয় তেতিয়া আমি অতি ক'ম দিনৰ ভিতৰতে বাঁহত ঘূণে ধৰে। যাৰফলত বাঁহৰ উৎপাদিত সামগ্ৰীসমূহ নষ্ট হৈ

যায়। ঘৰবনোৱা কামত ব্যৱহাৰ হোৱা বাঁহৰ খুটাবোৰ মাটিত লাগি থকা অংশটো সততে পঁচি যোৱা দেখা যায়। এইবোৰৰ প্ৰধান কাৰণ হ'ল বাঁহবোৰ ব্যৱহাৰ কৰাৰ আগতে ভালদৰে পৰিশোধন কৰি নোলোৱাটো। আজিকালি বিভিন্ন উপায়েৰে বাঁহবোৰ পৰিশোধন কৰি ল'ব পাৰি।পৰিশোধিত বাঁহ ব্যৱহাৰ কৰিলে বাঁহৰ প্ৰয়োগকাল কেইবাগুণো বাঢ়ি যায়। বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠানে বাঁহৰ পৰিশোধনৰ ওপৰত বহুবোৰ কাৰ্য্যসম্পাদন কৰি আছে। এই প্ৰতিষ্ঠানত অলপতে বাঁহ শোধন কৰিবৰ বাবে এটি অত্যাধুনিক যন্ত্ৰ স্থাপন কৰা হৈছে। ইয়াৰ জৰিয়তে অলপ সময়ৰ ভিতৰতে প্ৰায় ৫০-৫৫ ডালমান বাঁহ পৰিশোধন কৰিব পৰা যাব। প্ৰতিষ্ঠানত এই বিষয়ে প্ৰশিক্ষণৰো ব্যৱস্থা আছে।

ঙ) বাঁহৰ গাঁজ প্ৰসংস্কৰণ আৰু মূল্য সংজোজনঃ

বাঁহৰ গাঁজৰ এখন ডাঙৰ বজাৰ আছে। অসম তথা উত্তৰ-পূৰ্বাঞ্চলৰ লগতে সমগ্ৰ পৃথিৱীতে বাঁহ গাজৰ এখন অতি বিশাল ক্ষেত্ৰ আছে। অসমৰ ভলুকা আৰু কাক' বাঁহৰ গাঁজ অতি সুস্বাদু। এই বাঁহ গাঁজৰ লগত বিভিন্ন বস্তু যেনে – ভোট জলকীয়া, জলফাই, তেতেঁলী, কলডিল, নেমুটেঙা, কুকুৰাৰ মাংস, শুকান মাছ আদি মিহলাই মূল্য সংযোজিত কৰি বাঁহ গাঁজৰ বিভিন্ন খাদ্য সামগ্ৰী প্ৰস্তুত কৰিব পাৰি। কুটিৰ উদ্যোগ হিচাপে বাঁহ গাঁজ প্ৰস্তুত কৰি বিশেষকৈ মহিলাসকল স্বাৱলম্বী হোৱাৰ সম্পূৰ্ণ সুযোগ আছে। বৰ্ষাৰণ্য প্ৰতিষ্ঠানে ইতিমধ্যে বাঁহ গাঁজ প্ৰসংস্কৰণৰ এটি কোষ গঠন কৰি এই বিষয়ত প্ৰশিক্ষণ দি আহিছে।

চ) বাঁহৰ হস্তশিল্পঃ

বাঁহৰ পৰা তৈয়াৰী এশ এবুৰি সামগ্ৰী আছে যি সমূহৰ এখন খুব বহল বজাৰ পৰিলক্ষিত হয়। এনে ধৰণৰ ক্ষুদ্ৰ তথা মজলীয়া উদ্যোগসমূহ গঠন কৰি বহু যুৱক- যুৱতীয়ে আত্মসংস্থাপনৰ বাট মুকলি কৰিছে। এই সামগ্ৰীসমূহৰ স্থানীয় তথা আন্তঃৰাষ্ট্ৰীয় চাহিদাও আছে। নিবনুৱা সমস্যা কমোৱাৰ ক্ষেত্ৰত এই হস্ত- শিল্প উদ্যমিতা সমূহে যথেষ্ট গুৰিত্বপূৰ্ণ ভূমিকা পালন কৰি আহিছে। প্ৰতিষ্ঠানে বৰ্তমানলৈকে প্ৰায় তিনিহাজাৰমান এনে হস্তশিল্পীক প্ৰশিক্ষণ প্ৰদান কৰি আহিছে।

ছ) বাঁহ আৰু গৃহ নিৰ্মাণঃ

গৃহ নিৰ্মাণৰ ক্ষেত্ৰত বাঁহৰ নতুন নতুন প্ৰয়োগ দেখা গৈছে। পাৰস্পৰিক গৃহ নিৰ্মাণৰ পৰা আৰম্ভ কৰি বৰ্তমান সময়ত বিশ্বৰ বিভিন্ন ঠাইত বনোৱা বাঁহৰ অত্যাধুনিক ঘৰ সমূহে পৰ্য্যটন ক্ষেত্ৰখনক যথেষ্ট আকৰ্ষণ কৰিছে। বহুতো যুৱক- যুৱতী এই ক্ষেত্ৰখনত প্ৰৱেশ কৰি স্বাৱলম্বী হোৱাৰ সুন্দৰ সম্ভৱনা বিদ্যমান।

২) সাঁচিগছ- অসমৰ 'পনীয়া সোণ'ৰ উৎস:

সাঁচিগছ অসমত পোৱা আন এবিধ অতি মূল্যবান প্ৰাকৃতিক সম্পদ।এই সাঁচিসছৰ পৰা উৎপন্ন হোৱা অগৰু তেলৰ দাম ইমানেই বেছি যে ইয়াক 'পনীয়া সোণ' বুলি কোৱা হয়।এই গছৰ চাহিদালৈ লক্ষ্য ৰাখি বৰ্তমান চৰকাৰে সাঁচিগছৰ ওপৰত যথেষ্ট গুৰুত্ব আৰোপ কৰা দেখা গৈছে। সাঁচিগছৰ পুলি বাগান তৈয়াৰ কৰি বহু যুৱক- যুৱতী অৰ্থনৈতিকভাৱে উপকৃত হ'ব পাৰে। অসমৰ যিকোনো ঠাইৰ পানী জমা নোহোৱা ওখ চানেকীয়া মাটিত সাঁচি গছৰ খেতি খুব ভালদৰে কৰিব পাৰি। বৈজ্ঞানিক পদ্ধতিৰে সাঁচি গছৰ খেতি কৰিবলৈ আজিৰ প্ৰজন্ম ওলাই আহিব লাগে। সাঁচি গছত অগৰুতেল সৃষ্টি হোৱাটো এটা প্ৰাকৃতিক পৰিঘটনা। কিন্তু কিছুমান বিশেষ কাৰণত সকলো ঠাইতে হোৱা সাঁচি গছত অগৰুতেল সৃষ্টি নহয়। সাঁচিগছত অগৰুতেল সৃষ্টি হ'বলৈ হ'লে এই গছত কিছুমান বিশেষ পোক আৰু ভেঁকুৰে আক্ৰমণ কৰি গছজোপা বেমাৰী কৰিব লাগিব। এনেধৰণৰ বেমাৰী গছৰ পৰাহে অগৰুতেল নিষ্কাষণ কৰিব পাৰি। এই প্ৰাকৃতিক পৰিঘটনাৰ ফলত বেমাৰী নোহোৱা গছবোৰত অগৰুতেল সৃষ্টি নহয়। এনেবোৰ গছত কৃত্ৰিম পদ্ধতিৰ জৰিয়তে ভেঁকুৰৰ ইন'কুলাম (Inoculum) প্ৰয়োগ কৰি অগৰুতেল উৎপাদন কৰিব পাৰি। বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠানে ইতিমধ্যে কৃত্ৰিমভাৱে অগৰুতেল সৃষ্টিকাৰী তিনিটা ভেঁকুৰ আৱিষ্কাৰ কৰি ইয়াৰ ইন'কুলাম তৈয়াৰ কৰে। অসমৰ মাননীয় মুখ্যমন্ত্ৰীয়ে এই ইন'কুলাম যোৱা ১৯/০৮/২০২১ তাৰিখে ৰাইজৰ বাবে উৎসৰ্গা কৰে। প্ৰতিষ্ঠানে এই ইন'কুলামৰ এটা বহুল প্ৰয়োগৰ বাবে তামিল্‌নাড়ুৰ এটি প্ৰতিষ্ঠানৰ লগত চুক্তি কৰি স্বত্ব বিক্ৰী কৰিছে। অসম তথা উত্তৰ-পূৰ্বাঞ্চলৰ ইচ্ছুক ব্যক্তি বা প্ৰতিষ্ঠানেও এই ইন'কুলাম সমূহৰ স্বত্ব ক্ৰয় কৰি বহুল প্ৰয়োগ কৰিব পাৰে। প্ৰতিষ্ঠানত আগৰৰ লগত জড়িত সকলো দিশ সামৰি প্ৰশিক্ষণৰ সুন্দৰ ব্যৱস্থা আছে। যুৱক- যুৱতীসকলে এই ক্ষেত্ৰত আগবাঢ়ি আহি ইয়াৰ সুযোগ গ্ৰহণ কৰিব পাৰে।

৩) 'লা'- গছৰ খেতিঃ

'লা' হ'ল এবিধ বিশেষ পোকৰ সৃষ্ট এটি ধূণা জাতীয় পদাৰ্থ। অসমৰ হাবি জংঘলত আগতে যথেষ্ট পৰিমাণে 'লা' পোৱা গৈছিল। বগৰী, পলাশ আদি গছবোৰত 'লা' প্ৰাকৃতিকভাৱে পোৱা যায়। 'লা'ৰ এখন সুন্দৰ বজাৰ আছে। 'লা' বিভিন্ন কামত ব্যৱহাৰ হয়। গোপনীয় তথ্যপাতি 'লা'ৰ ছীল মাৰি সুৰক্ষিত কৰাৰ পৰা আৰম্ভ কৰি সুৰাত ৰং দিয়া, অলংকাৰ তৈয়াৰ কৰা, ঔষধ উদ্যোগত ব্যৱহাৰ কৰা আদি বহুতো প্ৰয়োগ আছে। বিজ্ঞানসন্মতভাৱে খেতি কৰিবৰ বাবে *Flemingia semialata* নামৰ এবিধ গছ চিনাক্ত কৰা হৈছে। এই গছৰ খেতি কৰি বছৰত দুবাৰকৈ 'লা' চপাব পাৰি। বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠানত এই সম্পৰ্কে প্ৰশিক্ষণ প্ৰদান কৰাৰ লগতে পোক আৰু গছবিধৰ গুটিৰ যোগানৰো ব্যৱস্থা আছে।

৪) ঝাড়ুগছৰ বাণিজ্যিক খেতিঃ

অসমৰ হাবি জংঘলত পোৱা ঝাড়ুগছ এবিধ বনজ সম্পদ। আমাৰ পাহাৰীয়া জিলা কেইখনত এই ঝাড়ুগছ প্ৰচুৰ পৰিমাণে পোৱা যায়। ইয়াৰ ওপৰিও মেঘালয়তো এই গছ যথেষ্ট পৰিমাণে আছে। এই গছৰ বানিজ্যিক খেতি কৰিও আমি যথেষ্ট পৰিমাণে উপকৃত হ'ব পাৰোঁ। অতি সহজে এই খেতি কৰিব পৰা যায়। বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠানে এই খেতিৰ ওপৰত বিভিন্ন পৰীক্ষা নীৰিক্ষা কৰিছে আৰু খেতি সম্পৰ্কীয় প্ৰশিক্ষণৰ ব্যৱস্থাও আছে।

৫) পেলনীয়া সামগ্ৰীৰ পৰা কেঁচুসাৰ তৈয়াৰঃ

পচন সাৰ তথা কেঁচুসাৰ হৈছে শস্যত ব্যৱহাৰ কৰা অতি উত্তম সাৰ। আমাৰ চাৰিওফালে পৰি থকা জাবৰ- জোঠৰ, গছ- গছনিৰ পাত আদিবোৰ সংগ্ৰহ কৰি এই সাৰবিধ প্ৰস্তুত কৰা হয়। আত্মসংস্থাপনৰ দিশত থকা এটি সময়োপযোগী উদ্যমিতা। অসমৰ বিভিন্ন ঠাইত কেঁচুসাৰ প্ৰস্তুত কৰি বহুব্যক্তি স্বাৱলম্বী হ'ব পাৰিছে যদিও এই দিশত আৰু বহুবোৰ কৰণীয় আছে।

৬) সুগন্ধি তথা ঔষধ যুক্ত গছ-গছনিঃ

আমাৰ চাৰিওফালে থকা জংঘল সমূহ বিভিন্ন প্ৰকাৰৰ সুগন্ধি তথা ঔষধজাতীয় গছ-গছনিৰে ভৰি আছে। এইবোৰ যথাযথভাৱে সংগ্ৰহ কৰি বা এইবোৰৰ খেতি কৰিও বহুতো যুৱক- যুৱতীয়ে আত্মসংস্থাপনৰ বাট মুকলি কৰিব পাৰে। অসমৰ জলবায়ু, মাটি আদি গছ- গছনিৰ বাবে অতি সুবিধাজনক।

এই লেখাটিৰ জৰিয়তে বনভিত্তিক যিবোৰ স্ব- নিয়োজনৰ পথ আছে তাৰ কিছু আভাস দিয়া হ'ল।বৰ্তমান সময়ত ভাৰত চৰকাৰেই হওঁক বা অসম চৰকাৰেই হওঁক বিভিন্ন জনকল্যাণমুখী আঁচনিসমূহ ৰূপায়িত কৰা দেখা গৈছে। ইয়াৰ বাহিৰেও বিভিন্ন অনুষ্ঠান প্ৰতিষ্ঠানে কৰিকৰী দিশত সহায়ৰ হাত আগবঢ়াই আহিছ। মাত্ৰ আজিৰ যুৱচামে এই সুবিধা সমূহৰ সম্পূৰ্ণ সুযোগ গ্ৰহণ কৰি নিজকে প্ৰতিষ্ঠা কৰিবৰ বাবে অহোপুৰুষাৰ্থ কৰিব লাগে।

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জৈৱিক ইন্ধন- বাঁহ কয়লা

ৰুনুমী দেৱী বৰঠাকুৰ
মুখ্য কাৰিকৰী বিষয়া
ভা.ব. অ.শি. প.বৰ্ষাৰণ্য গৱেষণা প্রতিষ্ঠান, যোৰহাট

বাঁহ – পৃথিৱীৰ ভিতৰত আতাইতকৈ ওখ তৃণজাতীয় এবিধ উদ্ভিদ – যাক বিভিন্ন আলংকৰিক বিশেষণেৰে বিভূষিত কৰা হয় – সেউজীয়া সোণ, দুখীয়াৰ কাঠ, একবিংশ শতিকাৰ আশৰ্যতম উদ্ভিদ ইত্যাদি, সমগ্র পৃথিৱীতে প্রায় ১২৫০ বিধ প্রজাতিৰ বাঁহ আছে, তাৰে প্রায় ১৩৬ বিধ প্রজাতিৰ বাঁহ ভাৰতবর্ষত উপলব্ধ । আমাৰ উত্তৰ পূর্বাঞ্চলত প্রায় ৯০ বিধমান প্রজাতিৰ বাঁহ পোৱা যায়, তাৰে ৪১ বিধমান থলুৱা প্রজাতিৰ বাঁহ । প্রকৃতিৰ অন্যতম উপহাৰ বাঁহ উত্তৰ পূর্বাঞ্চলত প্রচুৰ পৰিমানে উপলব্ধ আৰু ইয়াৰ সমাজ জীৱনৰ লগত ওতঃপ্রোতঃ ভাৱে জড়িত এবিধ অৱিচ্ছেদ্য অংগ ।

ঘৰ সজাৰ পৰা আৰম্ভ কৰি দৈনন্দিন ব্যৱহার্য্য বহুতো সঁজুলি, , কৃষিকার্য্যত ব্যৱহৃত সঁজুলি আনকি কাগজ প্রস্তুত কৰণতো বাঁহ ব্যৱহাৰ কৰা হয়, বর্তমান সময়ত বাঁহৰ টাইলছ , চৌকাঠ, টিঙ আনকি বাঁহৰ বস্ত্রত বজাৰত উপলব্ধ, ইন্ধন হিচাপে কাঠ/ বাঁহক পুৰণি কালৰ পৰাই ব্যৱহাৰ কৰি অহা হৈছে, সাম্প্রতিক কালৰ পৰিবর্তিত পৰিস্থিতিত "দুখীয়াৰ কাঠ" বাঁহক কৌশলপূর্ণ প্রযুক্তিৰ সহায়ত কয়লালৈ পৰিবর্তিত কৰি এক বৈপ্লৱিক সূচনা আনিবলৈ সমর্থ হৈছে । বাঁহ কয়লা হৈছে বৈজ্ঞানিক প্রযুক্তি সহায়ত উৎপাদন কৰা মূল্যসংযোজিত এবিধ সামগ্রী, য'ত ৮৫-৯০% কার্বন আৰু অতি ক'ম পৰিমাণৰ উদ্বায়ী পদার্থ আৰু ছাঁই থাকে। বাঁহ কয়লা প্রস্তুত কৰিবলৈ বায়ুৰুদ্ধ পৰিৱেশৰ লগতে অধিক উষ্ণতাৰ প্রয়োজন, বায়ুৰুদ্ধ পৰিৱেশত যেতিয়া বাঁহখিনি কয়লালৈ পৰিৱর্তন হয় আৰু বিশেষ কিছুমান গুণ/ধর্ম ই আয়ত্ত কৰি লয়। বিভিন্ন প্রকাৰৰ কৌশল প্রয়োগ কৰি বাঁহক কয়লালৈ পৰিৱর্ত্তন হয়, তাৰ ভিতৰত অতিকৈ পুৰণি পদ্ধতি হৈছে মাটিত গাত খান্দি তাত বাঁহ জাপি জ্বলোৱা, বাঁহখিনি গাততোত জাপি লোৱাৰ পাছত পুনৰ মাটিৰে গাঁততো বন্ধ কৰি ওপৰলৈ ধোঁৱা ওলাই যাবলৈ এটা ফুটা ৰাখি বাঁহখিনি জ্বলাই দিব লাগে। এই পদ্ধতিত কয়লা প্রস্তুত কৰিবলৈ ১৫-২০ দিন সময়ৰ প্রয়োজন, তদুপৰি এই পদ্ধতিত মাত্র ১০-১৫ শতাংশ কয়লাহে পোৱা যায়। দ্বিতীয় পদ্ধতিতো হৈছে – কেৰাছিন বা অন্য ড্রামত বাঁহ ভৰাই জ্বলোৱা পদ্ধতি, এই পদ্ধতিত বাঁহখিনি ড্রামটোত উলম্ব বা অনুভুমিক ভাৱে জাপি তাৰ ভিতৰতে জ্বলাই দিয়া হয় নাইবা বাহিৰৰ পৰা জুই দি জ্বলোৱা হয়, এই পদ্ধতিৰ দ্বাৰাও অতি কম পৰিমাণৰ কয়লা উৎপাদন কৰিবলৈ ৰাষ্ট্রীয় বাঁহ প্রযুক্তিকৰণ সংস্থাৰ দ্বাৰা অনুমোদিত ইটা আৰু বোকামাটিৰে তৈয়াৰী কৰা গম্বুজ আকৃতিৰ ভাটিৰ দ্বাৰা কৰিব পৰা যায়, এই পদ্ধতিৰ দ্বাৰা উৎপাদন কৰা কয়লা

উন্নত মানৰ হোৱাৰ লগতে উৎপন্ন হোৱা কয়লাৰ পৰিমানো সন্তোষজনক, এই ভাটিতো সাধাৰণতে বাঁহনিৰ ওচৰতে নাইবা বাঁহ অনা নিয়া কৰিবলৈ সুচল স্থানত স্থাপন কৰিলে ভাল হয়। এই প্ৰযুক্তি ব্যৱহাৰ কৰি অতি ক'ম মূলধন দ্বাৰা স্ব- নিয়োজনৰ পথ মুকলি কৰাৰ লগতে আনকো সংস্থাপন দিব পৰা যায়।বাঁহক কয়লাৰ পৃষ্ঠভাগৰ ক্ষেত্ৰফল বহল আৰু ছিদ্ৰযুক্ত হোৱাৰ বাবে শোষণ কৰিব পৰা ক্ষমতা অধিক।সেয়েহে ইয়াক বিষাক্ত ৰাসায়নিক পদাৰ্থ, গেছ, গধুৰ ধাতুৰ শোষক হিচাপে ব্যৱহাৰ কৰা হয়, কৃষিকাৰ্য, অৰ্কিড, এন্থুৰিয়াম আৰু অন্যান্য গছ- গছনি, শাক-পাচলি আদিতো বাঁহকয়লা ব্যৱহাৰ কৰা হয়, পানী বিশুদ্ধকৰণতো বাঁহকয়লা ব্যৱহাৰ কৰা হয়, এনে ধৰনে বিশুদ্ধ কৰা পানীত সুষম মাত্ৰাত pH আৰু খনিজ লৱণ পোৱা যায়।তদুপৰি লোহা, পিতল, এলুমিনিয়াম আদি ঔদ্যোগিক প্ৰতিষ্ঠান বিলাকতো ধাতু শোধনত ইয়াৰ ব্যৱহাৰ কৰা হয়।

বৰ্তমান কালত বাঁহকয়লাৰ বহুল ব্যৱ্হাৰৰ পাছতো কিন্তু চাহিদা অনুসাৰে উৎপাদন অতি পুতৌজনক, বৈজ্ঞানিকভাৱে "বাঁহকয়লা" উৎপাদন কৰা প্ৰ প্ৰযুক্তিৰ সহায়ত পেলনীয়া বা বৰ্জিত বাঁহক মূল্য সংযোজনৰ দ্বাৰা ব্যৱসায়িক ভিত্তিত বজাৰ গ্ৰহণযোগ্য সম্পদলৈ পৰিবৰ্তিত কৰি স্বনিৰ্ভৰশীল হোৱাৰ লগতে পৰিবেশৰ ভাৰসাম্য ৰক্ষা কৰাতো অৰিহণা যোগাব পৰা হয়। বৰ্তমান সময়ৰ পৰিবৰ্তিত পৰিস্থিতি, বিশুদ্ধ আৰু নৱীকৰণ সম্পদৰ চাহিদা আৰু বাঁহৰ নতুন নতুন প্ৰয়োগৰ প্ৰতি লক্ষ্য ৰাখি ভাৰতীয় বন গৱেষণা আৰু শিক্ষা পৰিষদৰ অধীনৰ যোৰহাটৰ বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠানে এই ক্ষেত্ৰত পথ প্ৰদৰ্শকৰ ভূমিকা গ্ৰহণ কৰি আহিছে। প্ৰতিষ্ঠানটিত ইতিমধ্যে এটি বাঁহকয়লা প্ৰস্তুতকৰণ আহিলা স্থাপন কৰি বাঁহকয়লা উৎপাদন কৰি থকাৰ লগতে বিভিন্ন সময়ত এই প্ৰযুক্তিৰ প্ৰশিক্ষণ দি আহিছে।তদুপৰি এই প্ৰতিষ্ঠানে ইতিমধ্যে "ৰাষ্ট্ৰীয় হিমালয়ান অধ্যয়ন পৰিযোজনা"ৰ আৰ্থিক সাহাৰ্য্যত এটি প্ৰকল্পৰ জৰিয়তে কাৰ্বি আংলং জিলাত বাঁহকয়লা উৎপাদন কৰা দুটা ভাটিভাটি স্থাপন কৰি তেওঁলোকক সুবিধা প্ৰদান কৰাৰ লগতে প্ৰায় চাৰিশ(৪০০) জনমান লোকক প্ৰশিক্ষণ প্ৰদান কৰিছে। এই প্ৰকল্পটিৰ জৰিয়তে তেওঁলোকে অবাবত পেলাই দিয়া বাঁহৰ পৰা কয়লা উৎপাদন কৰি ব্যৱসায় কৰি আৰ্থিকভাৱে স্বছল হ'বলৈ সমৰ্থ হৈছে। গতিকে দেখা গৈছে যে পেলনীয়া বা বৰ্জিত বাঁহক সম্পদলৈ অৰ্থাৎ বাঁহকয়লালৈ পৰিবৰ্তিত কৰি আৰ্থিক স্বছলতাৰ দিশত এখোজ আগবাঢ়িব পৰা যায়।

-মোৰ এই ধৰা-

নিবেদিতা বৰুৱা দত্ত

মুখ্য কাৰিকৰী বিষয়া
ভা.ব. অ.শি. প.বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠান, যোৰহাট

নীলা আকাশৰ তলত
শ্যামলী সাজেৰে সুশোভিত
মোৰ এই ধৰা,
সুৰুজৰ ৰঙাঁ কিৰণে
আনি দিয়ে
একোটি নৱ পূৱা ।

পৰ্বত পাহাৰ নদ-নদীৰ সমাহাৰত
হৈ উঠে
প্ৰকৃতি উতলা,
ৰিব ৰিব মলয়া,ৰিমঝিম বৰষুণে
কৰি তোলে
প্ৰকৃতিক বিনন্দীয়া।

নানা ৰঙৰ ফল ফুলেৰে
সানি দিয়ে মধুৰতা,
পশু -পক্ষীৰ সংগমে
বোৱাই তোলে প্ৰেমৰ ধাৰা।

চন্দ্ৰমাৰ স্নিগ্ধ জোনাকত
জিলিকি উঠে
আকাশত তিৰবিৰাই থকা তৰা
ধৰাৰ বুকুত
নাচি উঠে
জোনাকী পৰুৱাৰ খেলা ।
অনুপম সৌন্দৰ্য্যই
আপ্লুত মোৰ এই পুণ্য ধৰা
প্ৰকৃতিৰ সকলো ৰঙঁতে
আমি হওঁ আপোন পাহৰা।

অৰণ্য

লোহিত চন্দ্ৰ তামুলী

ভা.ব. অ.শি.প.-বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠান, যোৰহাট

এদিন আছিলোঁ আমি আদিম,অজ্ঞ,অঘৰী
প্ৰকৃতিৰ উন্মুক্ত কোলাত সাৰথি আছিল অৰণ্য;
মৌলিক প্ৰয়োজন পূৰণ জীৱনৰ উত্তৰন হেতু
শিক্ষা,জ্ঞান তথা সমলৰ অন্যতম উৎস।

লজ্জা নিবাৰণ হেতু গছৰ বাকলি বসন
আজিও বস্ত্ৰৰ বাবে উদ্ভিদেই প্ৰধান সমল; ভোকত জৰ্জৰিত হৈ
হাত মেলো উদ্ভিদলৈ
ৰোগত কাতৰ হলে ঔষধ কৰো আহৰণ।

জাৰ,জহ,বিপদত অৰণ্যই দিলে আশ্ৰয়
ইতৰ প্ৰাণীক বুজি সাজিব শিকিলো ঘৰ;
নিজৰ কল্যাণৰ বাবে গছক বলি দিলো
পৰিচয় দিলো আমি জীৱশ্ৰেষ্ঠ,উন্নত মানৱৰ।

অকৃতজ্ঞ মানৱ জাতিক বিজ্ঞানৰ অৱদান দি
বিৰিখে জীৱন দিয়ে বিশুদ্ধ বায়ু যোগাই ;
বিজ্ঞানেৰে যন্ত্ৰ গঢ়ি ক্ষিপ্ৰতাৰে গছ কাটি
মানুহে প্ৰতিদান দিয়ে গছৰ আয়ুস কমাই।

আধুনিক শিক্ষা ল'লো উন্নত বৃত্তি পালো
গৰ্বৰে পৰিচয় দিও অৰণ্যৰ সেৱক বুলি;
অৰ্থৰ বাবেই মাথো গোপনে অৰণ্য বিনাশো
তথাপি লাজ নকৰোঁ যদিও নগ্ন আমি।

গুণী,জ্ঞানী মনিষীসকলে উপদেশ,পৰামৰ্শ দিয়ে
জীৱনৰ শেষ বয়সত বানপ্ৰস্থ উত্তম উপায়;
আমি মহাজ্ঞানী হ'লো প্ৰকৃতিৰ বিপৰীতে চলো
অৰণ্যকে দিব খোজোঁ অকালতে অন্তিম বিদায়।

অৰণ্যই যুগে যুগে স্বধৰ্ম বৰ্তাই ৰাখে
মানৱে ছায়াতে জিৰায় জ্ঞান,প্ৰেৰণা নাপায়;
অৰণ্যক গ্ৰাস কৰে স্বাৰ্থান্ধ,অবিবেকী জনঅৰণ্যই
নিজৰ লগতে জগতৰ অন্তহীন বিপদ চপায়।

বিশ্বৰ সুবিশাল জনগণৰ সামান্য সংখ্যকে অৰণ্য গঢ়ে
জীৱন ধন্য সিসবৰ,জনাওঁ সশ্ৰদ্ধ প্ৰণাম;
প্ৰত্যেক মানৱে যদি কিছু অৱদান দিয়ে
ধৰণী হৈ ৰব বিশ্বব্ৰহ্মাণ্ডৰ শ্ৰেষ্ঠতম স্থান।।

অৰণ্য বিভীষিকা / অৰণ্য ৰোদন/ ভাৰ জিন ফৰেষ্ট।

প্ৰনৱ কুমাৰ গোস্বামী

কাৰিকৰী বিষয়া

ভা.ব. অ.শি. প.বৰ্ষাৰণ্য গৱেষণা প্ৰতিষ্ঠান, যোৰহাট

নয়না বৰুৱা: অতি অধূনীক যুৱতী ৰেইনজাৰ।
লেঙেৰা মানুহ: হিন্দী ভাষি কাঠৰ মহলদাৰ
মনোজ দত্ত: চোৰাং কাঠ ফলা কনটেন্টৰ আৰু নয়নাৰ প্ৰেমিক।
ভাচকৰ: ডিটেকটিভ
লেঙেৰা মানুহ আৰু মনোজৰ মাজত হোৱা কথা
লে: মনোজ ভয়া মই কাঠ টো নপালে মিল কেনেকে চলিব, ধান্দা মন্দা হৈ জাব।
মনোজ: কোনে কৈছে আপোনি কাঠ নাপাব
লে: কেলেই এই যোৱা ন চকৰী ৰেইনজাৰ টো লকৰী কাটিব নাদিছে।
ম: এই টো কোনো টেনশন, নাই। তাই টো মোৰ ফেৰন্দ হয়।
লে: তাকে আপনি জানে। তবে লকৰী ভি মিলিগে অৰ ৰ হা : হা হা: লেকিন কোনো দিকদাৰী হব নেকি?
ম: কোনো লেকিন ফেকিন নাই। তাই ক কেনেকৈ প্ৰেমৰ জালত পেলাব লাগে সেই য়া মই জানো। আৰু যদি নপতে গছো কাতিম তাইতো শেষ কৰি দিম।

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নয়: জানা মনোজ মই অৰণ্য বৰ ভাল পাও। ইয়াৰ প্ৰতি জোপা গছে মোৰ লগত কথা পাতে। সেই জিলীৰ মাত শোনিচা , সেই মাত শুনিলেই মোৰ নিজেৰ ঘৰ খনলৈ অহা জেনে লাগে।
ম: সচাই তুমি অৰণ্য খুব ভাল পোৱা।
ন: ও।
ম: আৰু মোক। কি হল একো নমাতিলাজে।
ন: সকলো কথা কোৱা নেজাই। মোৰ চকুলৈ চোৱা মনোজ, কি দেখিচা , (দুয়ো চাই থাকে) ,
ম:(দুবাহো মেলি) নয়না মোৰ বুকুৰ মাজলৈ আহা,
ন: ন্ মনো, ভাৰ জিন ফৰেষ্ট ভাৰ জিন হৈ থাকিবলৈ দিয়া, আফতাৰ অল বিয়া হৈ নোহোৱা লৈকে।
ম: দুষ্ট ছোৱালী, বেয়া পালো তোমাক।
ন: অস্ মনো, এবাৰ হাহি দিয়া না, প্লিজ, তুমি হাহিলে, তোমাৰ মোৰ খন ইমান মৰম লাগে, সৰু লৰা নিচিনা কৈ গালত চিকুটি দিব মন যাই। (দুয়ো চাই হাহে) বলা এতিয়া যাও।
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লে: (টেবিল ত ৰঙা পানী লৈ) আহক, আহক, মনোজ বাবু, মই ভি আপনাৰ বাবে ৰৈআছে। কি খবৰ আছে, লাকৰী কাটছে,

ম: নাই নাই। ইমান তাৰা তাৰী নহয়।
লে: আৰু কিমান ওৰেত কৰাব বাবু।
ম: কাইলৈ মই মাৰকিং কৰা আৰু পৰহিলৈ মাৰকিং নকৰা গছ কতাম।
লে: বেছি দেৰি নকৰিব। ধান্দা বন্ধ ৰাখিব নোৱাৰি। আৰু
ম: আৰু কি?
লে: লকৰী কি চাঠ চাঠ, চকৰী ভি হলে আপোনাৰ কমিশন দবল হব হা, হা,
ম: দন। চিয়েচ্।
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ন: ডিটেকটিভ ভাচকৰ, মোৰ কেচ টো তুমি লবানে? (ফোন ত)
ভা: তুমি দিয়া কেচ মই নলম হবৈ নোৱাৰে। দন।
ন: থেংকিও, মাই চুইত হাট্।
ভা: কিন্তু, আমাৰ বিয়া খন কেতিয়া হব।
ন: চবৰ কৰো বচ্চে। ইনট্াজাৰ কি ফল মিঠা হয়। মোৰ সোন। বাই।
ম: আৰে নয়না।
ন: কিয়, মোক দিখি ভয় খালা নেকি? বাৰু মনোজ, মাৰকিং নকৰা গছ বোৰ কিয় কতাইছা?
ম: মাৰকিং খিনি চৰকাৰৰ ৰেভিনিও আৰু নকৰা খিনি মোৰ আৰু তোমাৰ।
ন: নহয় নহয় মনো, এনেকৈ গছ কাতিলে অৰণ্য ধংশ হৈ যাব। নাই মনো, তুমি গছ কটা বন্ধ কৰা।
ম: মই গছ কটা বন্ধ নকৰো, লাগিলে তোমাৰ মুখ চিৰদিনৰ কাৰণে বন্ধ কৰি দিম।
ন: তুমি এনেকৈ কবলৈ কত সাহস পালা? পাহৰি নাজাবা মই এই বনানী ৰ চৰকাৰী বন বিষয়া।
ম: হা, হা, এতিয়া, তুমি মোৰ আৰু মহলদাৰ চিকাৰ। মহলদাৰ, ৰচি দিয়া এই হাট দুখন জপটিয়াই বান্ধি লও।
ন: এয়া তুমি কি কৰিব ওলাই ছা
ম: প্রথম মই তাৰ পিছত মহলদাৰ তুমি হা, হা,
ন: নিলজ্জ মনোজ, (এক গোৰ দিয়ে)
ম: আহ, মাটিতে পৰি যায়। ৰহ টোক আজি মই শেষ কৰি দিম। চুৰি ওলিয়া পেতত সোমাব খোজোতে , হাতত গুলি লাগে। আৰু চুৰি পৰি যায়।
লে: গুলি কোনে মাৰিলে,
ভা: মই মাৰিলো, পলাবলৈ চেষ্টা নকৰিব মহলদাৰ, মোৰ ৰিভলভাৰ ৫টা গুলি তুমাৰ লাও খোলা উৰাই দিম। মই দিটেকটিভ ভাচকৰ। আৰু নয়নাৰ সচা প্রেমিক। আহা নয়না তুমাক মুক্ত কৰি দিও। তুমি য়ে হিহতৰ শেষ শাস্তি দি দয়া।
ন: ঐ উথ, এই অৰণ্য দষ্যু এটা এটা কৈ তহতক গুলি য়াম।
ম+ মহ: নহয়, নহয়, আমাক প্রানে না মাৰি বা আমিও অৰণ্য দষ্যু নহৈ বন্ধু হম।
হয় আমি সকলো এই পন লও
আমি অৰণ্যৰ দষ্যু নহয় বন্ধু হম।
সমাপ্ত।

মিজোৰাম

ভূবন কছাৰী
কাৰীকৰী বিষয়া
ভা.ব.অ.শি.প.- বাঁহ আৰু বেত কেন্দ্ৰ, আইজল, মিজোৰাম

উত্তৰ পূৱ কোণৰ ওখ পাহাৰত অৱস্থিত মিজোৰাম হৈছে অন্তহীন বৈচিত্ৰৰ প্ৰাকৃতিক দৃশ্য, পাহাৰীয়া ভূ-খণ্ড, মেৰুকৰনী নৈৰ গভীৰ গৰ্জন, উদ্ভিদ আৰু প্ৰাণীৰ চহকী সমৃদ্ধিৰ সৈতে প্ৰাকৃতিক সৌন্দৰ্য্যৰ ভঁৰাল। পূৱে আৰু পশ্চিমে বাংলাদেশ আৰু দক্ষিণে ম্যানমাৰ আগুৰি থকা মিজোৰামে ৭২২ কিঃ মিঃ দীঘলীয়া আন্তৰাষ্ট্ৰীয় সীমাৰেখাৰে গুৰুত্বপূৰ্ণ স্থান দখল কৰিছে। আতিথ্যৰ বাবে বিখ্যাত মিজোসকল হৈছে এক ঘনিষ্ঠ সমাজ য'ত কোনো শ্ৰেনীগত পাৰ্থক্য নাই আৰু লিংগৰ ভিত্তিত কোনো বৈষম্য নাই। সমগ্ৰ সমাজখনক এক অদ্ভূত নৈতিকতা বিধি Tlawmngaihna এটা অনুবাদ কৰিব নোৱাৰা শব্দৰ দ্বাৰা একেলগে বান্ধি ৰখা হৈছে যাৰ অর্থ সকলো ফালৰ পৰা অতিথিপৰায়ণ, দয়ালু, নিস্বার্থ আৰু আনৰ প্ৰতি সহায়কাৰী হোৱা।

<u>ভূমিঃ</u> ১৯৮৭ চনৰ ফেব্ৰুৱাৰী মাহত ভাৰতৰ ২৩ সংখ্যক ৰাজ্য হিচাপে পৰিগণিত হোৱা মিজোৰাম মূলতঃ এটা পাহাৰীয়া অঞ্চল। ১৯৭২ চনত কেন্দ্ৰীয় শাসিত অঞ্চললৈ পৰিণত হোৱালৈকে ই অসমৰ অন্যতম জিলা আছিল। ইয়াৰ পাহাৰৰ গড় উচ্চতা ৯০০মিঃ। সৰ্বোচ্চ শৃংগ হৈছে খাংলুই(নীলা পৰ্বত); ইয়াৰ উচ্চতা ২২১০ মিঃ। ইয়াৰ জলবায়ু সুখকৰ। সাধাৰণতে গ্ৰীষ্মকালত ই শীতল আৰু শীতকালত বৰ বেছি ঠাণ্ডা নহয়, শীতকালত উষ্ণতা ১১ ডিগ্ৰী ছেলছিয়াছৰ পৰা ২১ ডিগ্ৰী ছেল্‌ছিয়াছ আৰু গ্ৰীষ্মকালত ২০ ৰ পৰা ২৯ ডিগ্ৰী ছেলছিয়াছৰ ভিতৰত থাকে। এপ্ৰিল মাহৰ মাজভাগত ধুমুহাই গৰমৰ আৰম্ভণিৰ আগজাননী দিয়ে ।

ইতিহাসবিদৰ মতে মিজোসকল শতিকা আগতে পূৱ আৰু দক্ষিণ ভাৰতলৈ ছিটিকি পৰা মংগোলীয় জাতিৰ মহান টোৰ এটা অংশ। নৱম শতিকাত তেওঁলোক ব্ৰিটিছ মিছনেৰীসকলৰ প্ৰভাৱত পৰিছিল আৰু বৰ্ত্তমান অধিকাংশই খ্ৰীষ্টিয়ান।

"পাউলকুট" হৈছে মিজোসকলৰ শষ্য চপোৱা এক উৎসৱ । ডিচেম্বৰৰ পৰা জানুৱাৰী মাহৰ ভিতৰত এই উৎসৱ উদযাপন কৰা হয়। মিজোৰামৰ এক আচৰিত কথা হ'ল ইয়াৰ পাহাৰৰ মাজে মাজে থকা সৰু দোকানবোৰ য'ত মানুহে বস্তু কিনিবলৈ যায় কিন্তু দোকানীসকল লগ পোৱা নাযায়। এই দোকানবোৰৰ নাম "Nahahloudawr" বুলি জনা যায়। ঘাই পথৰ প্ৰায় ৫৫ কিঃমিঃ দূৰত্বত উপলব্ধ এই দোকানবোৰ। দোকানৰ বস্তুবোৰ এটা ক্ৰমত সজাই থোৱা হয় আৰু প্ৰটিটো বস্তুৰে নাম লিখা থাকে, লগতে এটা পইচা ভৰোৱা টেমা থাকে। গ্ৰাহকে বস্তুবোৰ কিনাৰ পাছত নিৰ্ধাৰিত কৰি থোৱা টকাৰ

পৰিমাণ টেমাৰ ভিতৰত ভৰাই থৈ যায়। মই এজন মানুহক এই বিষয়ত সোধাত ক'লে যে- ধৰা হওঁক দোকানখনত ৫০০ টকাৰ বস্তু আছে, সেই ৫০০ টকাৰ কাৰণে এজন মানুহ দিনৰ দিনটো বহি নাথাকে। দোকানসমূহ সকলো সম্পূৰ্ণ বিশ্বাসত চলে। বাকী সময়খিনি অন্য কাম বা খেতি পথাৰত কাম কৰিবলৈ যায়। সমগ্ৰ ভাৰতত এনে উদাহৰণ নাই যেন অনুমান হয়।

সাধাৰণতে দোকানবোৰৰ দোকানী প্ৰায় মহিলা, যিকোনো ধৰণৰ ব্যৱসায় মহিলাসকলে কৰা দেখা যায়। Flipkart, Amazon ৰ বস্তু deliver কৰিবলৈ মহিলাসকল ৰাতি ৯ বজালৈকে ঘৰে ঘৰে যোৱা দেখা যায়। ইয়াৰ সকলো পুৰুষ মহিলাই ধুম্ৰপান কৰা দেখা যায়।

মই য'ত থাকোঁ ঠাইডোখৰৰ নাম – Bethlehem Vengtlang. আমাৰ অফিচটো ইয়াতেই অৱস্থিত, আমাৰ বাসগৃহৰ নিচেই ওচৰতে আছে এখন কবৰস্থান। ৰুমৰ খিড়িকী খুলি দিলেই কবৰস্থানখন দেখা পোৱা যায়। কবৰস্থান খন খুৱ পৰিপাটীকৈ থোৱা দেখা যায়। তাতে ওচৰ চুবুৰীয়াৰ ল'ৰা ছোৱালী বিলাকে খেলি থাকে। য'দি কোনোবা মানুহৰ মৃত্যু হয় তেতিয়া মানুহজনৰ ক'ত কেতিয়া আৰু কিয় মৃত্যু হ'ল নাম ঠিকনাসহ মাইকত ঘোষণা কৰি দিয়ে। ঘোষণা শুনাৰ পাছত অঞ্চলটিৰ সকলো মানুহে মৃতকৰ ঘৰলৈ বুলি ১ কেজি চাউল আৰু ১ লিঃ গাখীৰ আগবঢ়ায়। সেই বস্তুবোৰ সংগ্ৰহ কৰিবলৈ সমাজৰ একোজন ব্যক্তিক দ্বায়িত্ব দিয়া হয় আৰু সেইমতে ব্যক্তিজনে ঘৰে ঘৰে গৈ সেই বস্তুবোৰ সংগ্ৰহ কৰি মৃতকৰ ঘৰত দি থৈ আহে। মৃত্যুৰ দিনা অঞ্চলটিৰ সকলো মানুহ গৈ মৃতকৰ সৈতে বংশ পৰিয়ালৰ সকলো মানুহে শেষবাৰৰ বাবে একপি ফটো তোলে।

শণিবাৰে ইয়াত এখন সাপ্তাহিক বজাৰ বহে। বস্তুবোৰ সকলো মহিলাই বিক্ৰী কৰে, বস্তুবিলাক সাধাৰণতে মুঠা হিচাপে বান্ধি বিক্ৰী কৰে, ওজন হিচাপে নহয়। বস্তুবিলাকৰ দাম বহুত বেছি- যেনেঃ তিনিটা তিয়ঁহত ৫০ টকা, ৯টা কেৰেলাত ৫০ টকা, ১ টা অমিতাত ২০০/৩০০ টকা আদি।

মিজোৰামবাসীয়ে শান্তিৰে বাস কৰিব বিচাৰে, কোনো হিংসা, হাই-কাজিয়া তেওঁলোকৰ মাজত দেখা নাযায়্। সেয়ে হয়তু ভাৰতবৰ্ষৰ ভিতৰতে শান্তিপ্ৰিয়, সুখী বুলি জনা যায়।

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ম: নাই নাই। ইমান তাৰা তাৰী নহয়।
লে: আৰু কিমান ওৰেত কৰাব বাবু।
ম: কাইলৈ মই মাৰকিং কৰা আৰু পৰহিলৈ মাৰকিং নকৰা গছ কতাম।
লে: বেছি দেৰি নকৰিব। ধান্দা বন্ধ ৰাখিব নোৱাৰি। আৰু
ম: আৰু কি?
লে: লকৰী কি চাঠ চাঠ, চকৰী ভি হলে আপোনাৰ কমিশন দবল হব হা, হা,
ম: দন। চিয়েচ্।
০০০০০০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ০ঃ
ন: ডিটেকটিভ ভাচকৰ, মোৰ কেচ টো তুমি লবানে? (ফোন ত)
ভা: তুমি দিয়া কেচ মই নলম হবৈ নোৱাৰে। দন।
ন: থেংকিও, মাই চুইত হাট্।
ভা: কিন্তু, আমাৰ বিয়া খন কেতিয়া হব।
ন: চবৰ কৰো বচ্চে। ইনট্াজাৰ কি ফল মিঠা হয়। মোৰ সোন। বাই।
ম: আৰে নয়না।
ন: কিয়, মোক দিখি ভয় খালা নেকি? বাৰু মনোজ, মাৰকিং নকৰা গছ বোৰ কিয় কতাইছা?
ম: মাৰকিং খিনি চৰকাৰৰ ৰেভিনিও আৰু নকৰা খিনি মোৰ আৰু তোমাৰ।
ন: নহয় নহয় মনো, এনেকৈ গছ কাতিলে অৰণ্য ধংশ হৈ যাব। নাই মনো, তুমি গছ কটা বন্ধ কৰা।
ম: মই গছ কটা বন্ধ নকৰো, লাগিলে তোমাৰ মুখ চিৰদিনৰ কাৰণে বন্ধ কৰি দিম।
ন: তুমি এনেকৈ কবলৈ কত সাহস পালা? পাহৰি নাজাবা মই এই বনানী ৰ চৰকাৰী বন বিষয়া।
ম: হা, হা, এতিয়া, তুমি মোৰ আৰু মহলদাৰ চিকাৰ। মহলদাৰ, ৰচি দিয়া এই হাট দুখন জপটিয়াই বান্ধি লও।
ন: এয়া তুমি কি কৰিব ওলাই ছা
ম: প্রথম মই তাৰ পিছত মহলদাৰ তুমি হা, হা,
ন: নিলজ্জ মনোজ, (এক গোৰ দিয়ে)
ম: আহ, মাটিতে পৰি যায়। ৰহ টোক আজি মই শেষ কৰি দিম। চুৰি ওলিয়া পেতত সোমাব খোজোতে , হাতত গুলি লাগে। আৰু চুৰি পৰি যায়।
লে: গুলি কোনে মাৰিলে,
ভা: মই মাৰিলো, পলাবলৈ চেষ্টা নকৰিব মহলদাৰ, মোৰ ৰিভলভাৰ ৫টা গুলি তুমাৰ লাও খোলা উৰাই দিম। মই দিটেকটিভ ভাচকৰ। আৰু নয়নাৰ সচা প্রেমিক। আহা নয়না তুমাক মুক্ত কৰি দিও। তুমি য়ে হিহতৰ শেষ শাস্তি দি দয়া।
ন: ঐ উথ, এই অৰণ্য দষু এটা এটা কৈ তহতক গুলি য়াম।
ম+ মহ: নহয়, নহয়, আমাক প্রানে না মাৰি বা আমিও অৰণ্য দষু নহৈ বন্ধু হম।
হয় আমি সকলো এই পন লও
আমি অৰণ্যৰ দষু নহয় বন্ধু হম।
সমাপ্ত।

মিজোৰাম

ভূবন কছাৰী
কাৰীকৰী বিষয়া
ভা.ব.অ.শি.প.- বাঁহ আৰু বেত কেন্দ্ৰ, আইজল, মিজোৰাম

উত্তৰ পূৱ কোণৰ ওখ পাহাৰত অৱস্থিত মিজোৰাম হৈছে অন্তহীন বৈচিত্ৰৰ প্ৰাকৃতিক দৃশ্য, পাহাৰীয়া ভূ-খণ্ড, মেৰুকৰনী নৈৰ গভীৰ গৰ্জন, উদ্ভিদ আৰু প্ৰাণীৰ চহকী সমৃদ্ধিৰ সৈতে প্ৰাকৃতিক সৌন্দৰ্য্যৰ ভঁৰাল। পূৱে আৰু পশ্চিমে বাংলাদেশ আৰু দক্ষিণে ম্যানমাৰ আগুৰি থকা মিজোৰামে ৭২২ কিঃ মিঃ দীঘলীয়া আন্তৰাষ্ট্ৰীয় সীমাৰেখাৰে গুৰুত্বপূৰ্ণ স্থান দখল কৰিছে। আতিথ্যৰ বাবে বিখ্যাত মিজোসকল হৈছে এক ঘনিষ্ঠ সমাজ য'ত কোনো শ্ৰেনীগত পাৰ্থক্য নাই আৰু লিংগৰ ভিত্তিত কোনো বৈষম্য নাই। সমগ্ৰ সমাজখনক এক অদ্ভূত নৈতিকতা বিধি Tlawmngaihna এটা অনুবাদ কৰিব নোৱাৰা শব্দৰ দ্বাৰা একেলগে বান্ধি ৰখা হৈছে যাৰ অর্থ সকলো ফালৰ পৰা অতিথিপৰায়ণ, দয়ালু, নিস্বার্থ আৰু আনৰ প্ৰতি সহায়কাৰী হোৱা।

ভূমিঃ ১৯৮৭ চনৰ ফেব্ৰুৱাৰী মাহত ভাৰতৰ ২৩ সংখ্যক ৰাজ্য হিচাপে পৰিগণিত হোৱা মিজোৰাম মূলতঃ এটা পাহাৰীয়া অঞ্চল। ১৯৭২ চনত কেন্দ্ৰীয় শাসিত অঞ্চললৈ পৰিণত হোৱালৈকে ই অসমৰ অন্যতম জিলা আছিল। ইয়াৰ পাহাৰৰ গড় উচ্চতা ৯০০মিঃ। সৰ্বোচ্চ শৃংগ হৈছে খাংলুই(নীলা পৰ্বত); ইয়াৰ উচ্চতা ২২১০ মিঃ। ইয়াৰ জলবায়ু সুখকৰ। সাধাৰণতে গ্ৰীষ্মকালত ই শীতল আৰু শীতকালত বৰ বেছি ঠাণ্ডা নহয়, শীতকালত উষ্ণতা ১১ ডিগ্ৰী ছেলছিয়াছৰ পৰা ২১ ডিগ্ৰী ছেল্‌ছিয়াছ আৰু গ্ৰীষ্মকালত ২০ ৰ পৰা ২৯ ডিগ্ৰী ছেলছিয়াছৰ ভিতৰত থাকে। এপ্ৰিল মাহৰ মাজভাগত ধুমুহাই গৰমৰ আৰম্ভণিৰ আগজাননী দিয়ে ।

ইতিহাসবিদৰ মতে মিজোসকল শতিকা আগতে পূৱ আৰু দক্ষিণ ভাৰতলৈ ছিটিকি পৰা মংগোলীয় জাতিৰ মহান টোৰ এটা অংশ। নৱম শতিকাত তেওঁলোক ব্ৰিটিছ মিছনেৰীসকলৰ প্ৰভাৱত পৰিছিল আৰু বর্ত্তমান অধিকাংশই খ্ৰীষ্টিয়ান।

"পাউলকুট" হৈছে মিজোসকলৰ শষ্য চপোৱা এক উৎসৱ । ডিচেম্বৰৰ পৰা জানুৱাৰী মাহৰ ভিতৰত এই উৎসৱ উদযাপন কৰা হয়। মিজোৰামৰ এক আচৰিত কথা হ'ল ইয়াৰ পাহাৰৰ মাজে মাজে থকা সৰু দোকানবোৰ য'ত মানুহে বস্তু কিনিবলৈ যায় কিন্তু দোকানীসকল লগ পোৱা নাযায়। এই দোকানবোৰৰ নাম "Nahahloudawr" বুলি জনা যায়। ঘাই পথৰ প্ৰায় ৫৫ কিঃমিঃ দূৰত্বত উপলব্ধ এই দোকানবোৰ। দোকানৰ বস্তুবোৰ এটা ক্ৰমত সজাই থোৱা হয় আৰু প্ৰটিটো বস্তুৰে নাম লিখা থাকে, লগতে এটা পইচা ভৰোৱা টেমা থাকে। গ্ৰাহকে বস্তুবোৰ কিনাৰ পাছত নির্ধাৰিত কৰি থোৱা টকাৰ

পৰিমাণ টেমাৰ ভিতৰত ভৰাই থৈ যায়। মই এজন মানুহক এই বিষয়ত সোধাত ক'লে যে- ধৰা হওঁক দোকানখনত ৫০০ টকাৰ বস্তু আছে, সেই ৫০০ টকাৰ কাৰণে এজন মানুহ দিনৰ দিনটো বহি নাথাকে। দোকানসমূহ সকলো সম্পূৰ্ণ বিশ্বাসত চলে। বাকী সময়খিনি অন্য কাম বা খেতি পথাৰত কাম কৰিবলৈ যায়। সমগ্ৰ ভাৰতত এনে উদাহৰণ নাই যেন অনুমান হয়।

সাধাৰণতে দোকানবোৰৰ দোকানী প্ৰায় মহিলা, যিকোনো ধৰণৰ ব্যৱসায় মহিলাসকলে কৰা দেখা যায়। Flipkart, Amazon ৰ বস্তু deliver কৰিবলৈ মহিলাসকল ৰাতি ৯ বজালৈকে ঘৰে ঘৰে যোৱা দেখা যায়। ইয়াৰ সকলো পুৰুষ মহিলাই ধুম্ৰপান কৰা দেখা যায়।

মই য'ত থাকোঁ ঠাইডোখৰৰ নাম – Bethlehem Vengtlang. আমাৰ অফিচটো ইয়াতেই অৱস্থিত, আমাৰ বাসগৃহৰ নিচেই ওচৰতে আছে এখন কবৰস্থান। ৰুমৰ খিড়িকী খুলি দিলেই কবৰস্থানখন দেখা পোৱা যায়। কবৰস্থান খন খুৱ পৰিপাটীকৈ থোৱা দেখা যায়। তাতে ওচৰ চুবুৰীয়াৰ ল'ৰা ছোৱালী বিলাকে খেলি থাকে। য'দি কোনোবা মানুহৰ মৃত্যু হয় তেতিয়া মানুহজনৰ ক'ত কেতিয়া আৰু কিয় মৃত্যু হ'ল নাম ঠিকনাসহ মাইকত ঘোষণা কৰি দিয়ে। ঘোষণা শুনাৰ পাছত অঞ্চলটিৰ সকলো মানুহে মৃতকৰ ঘৰলৈ বুলি ১ কেজি চাউল আৰু ১ লিঃ গাখীৰ আগবঢ়ায়। সেই বস্তুবোৰ সংগ্ৰহ কৰিবলৈ সমাজৰ একোজন ব্যক্তিক দ্বায়িত্ব দিয়া হয় আৰু সেইমতে ব্যক্তিজনে ঘৰে ঘৰে গৈ সেই বস্তুবোৰ সংগ্ৰহ কৰি মৃতকৰ ঘৰত দি থৈ আহে। মৃত্যুৰ দিনা অঞ্চলটিৰ সকলো মানুহ গৈ মৃতকৰ সৈতে বংশ পৰিয়ালৰ সকলো মানুহে শেষবাৰৰ বাবে একপি ফটো তোলে।

শণিবাৰে ইয়াত এখন সাপ্তাহিক বজাৰ বহে। বস্তুবোৰ সকলো মহিলাই বিক্ৰী কৰে, বস্তুবিলাক সাধাৰণতে মুঠা হিচাপে বান্ধি বিক্ৰী কৰে, ওজন হিচাপে নহয়। বস্তুবিলাকৰ দাম বহুত বেছি- যেনেঃ তিনিটা তিয়ঁহত ৫০ টকা, ৯টা কেৰেলাত ৫০ টকা, ১ টা অমিতাত ২০০/৩০০ টকা আদি।

মিজোৰামবাসীয়ে শান্তিৰে বাস কৰিব বিচাৰে, কোনো হিংসা, হাই-কাজিয়া তেওঁলোকৰ মাজত দেখা নাযায়্। সেয়ে হয়তু ভাৰতবৰ্ষৰ ভিতৰতে শান্তিপ্ৰিয়, সুখী বুলি জনা যায়।

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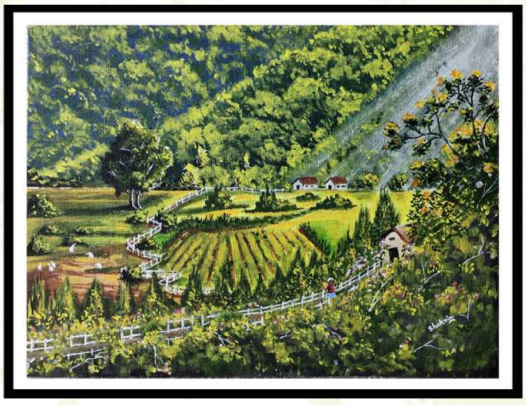
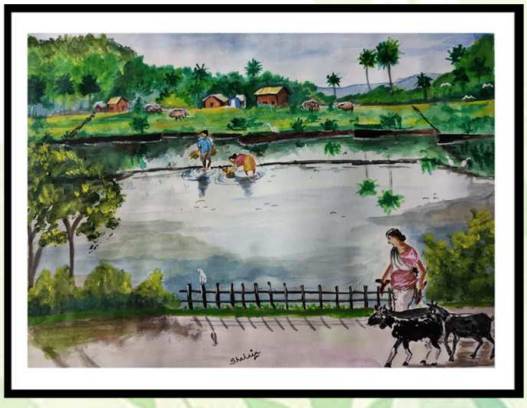
Paintings by Shanin Akhtar Islam

ICFRE- RFRI, Jorhat





Glimpses of ICFRE-RFRI Bambusetum

Bambusa tulda Roxb.

Bambusa balcoa Roxb.

Bambusa vulgaris Schrad. ex. Wendi

Bambusa pseudopallida Majumdar


Bambusa wamin E.G.Camus


Bambusa vulgaris var.striata (Lodd. ex Lindl.) Gamble

Dendrocalamus giganteus Munro.

Bambusa vulgaris Schrad. ex. Wendi

Melocanna baccifera Kurz.

Bambusa bambos Voss.


Guerlua angustifo Kunth

Bambusa nutans Wall. ex Munro.


Schizotachyum pergracile Majumdar

Bambusa nana Roxb.


Phyllostachys mannii Gamble

Sessa fortunei Van Houtte

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For more information contact:
Director,
ICFRE-Rain Forest Research Institute,
Jorhat, Assam-785010
Email : dir_rfri@icfre.org, Tel- 0376-2305101
Website: rfri.icfre.gov.in

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